Experimental Researches, Vol. I, Cat. 994

This notebook covers the periods October 1875-January 1876 and May 1877-October 1878. The entries on pages 1-60 are in the hand of Thomas Edison and Charles Batchelor and deal with the electric pen and duplicating press, etheric force, polarization, ore mining, batteries, chemical experiments, celluloid, and acoustic and domestic telegraphy. Some of the entries are signed and dated by Edison, Batchelor, and James Adams; others are signed and dated by Batchelor alone. Detailed drawings supplement the text.

A series of notes and drawings dealing with the development of the electric light has been copied into pages 113-204 by William Carman, Edison's bookkeeper. Pages 205-207 contain a copy of an "electric light law." (The originals of the material on pages 113-207 can be found in Unbound Notebook, Vol. 16 and Laboratory Scrapbook, Cat. 1146.) The book contains 640 numbered pages.

Blank pages not filmed: 62-99, 102-111, 210-640.

Illegible pages not filmed: 208-209.

Nay 6353 A

Black Autographic Ink

No 1

Tried lampblack and castor oil alone ground well in a mortar, it work exceedingly well.
Tried Glycerine and lampblack, dont work well there seems to be an antagonism between the two so that even a mechanical mixture seems almost impossible, the lampblack settles out, by rubbing the roller a great number of times over the stencil paper the ink assumes a very pale look, but if the finger is rubbed over it a dense black streak is seen. another phenomenon is noticed, the blue ruled lines upon the paper appear to repel the ink and show quite white. The mechanical mixture of lampblack with castor oil is so perfect that one would believe that it was soluable, though it is almost certain that it isn't.
The Castor oil-lampblack ink does not appear to blot through the paper enough to prevent the taking of a large number of copies. By placing Castor oil, Olive Oil, Codliver oil, Lard oil and Glycerine upon paper, the Olive oil came through first the Castor oil 4th and the glycerine did not come through for some time, the glycerine used was crude and quite thick though not any thicker than the castor oil. Common printing ink thinned with castor oil works perfectly, and if the printers ink is cheap enough leaves nothing more to be desired. Common printers ink does not mix at all with glycerine, at least there is an exceedingly poor mechanical mixture.
Powdered proto Fe and nutgalls put together and ground with glycerine gives a fair ink but has not a sufficient depth of color to be satisfactory. The most

perfect and conspicuous copies ever taken on the Autographic press were taken this evening with ink formed of printers ink skinned by castor oil and ground on a mortar some two weeks previously.

October 3. 1875 Thos A Edison.
Chas Batchelor. James Adams

No 2 Electrical Pen

In testing a new model pen this evening, one with all the mechanism put on an iron frame (cast) we found that it did not approach in power or speed the rubber frame pen made by John Ott, the spools of the iron frame pen were two sizes of wire longer than Otts magnets, thinking perhaps that the resistance was too great or that owing to the greater number of convolutions the self induction delayed magnetization we unwound one layer from each spool, but this did not appear to increase the power or speed materially, we then tested R on Galvanometer of both pens & found them about the same. We used the cast iron frame as a yoke to the engine magnet and found by testing that there were free poles at the points where the cores are connected to the cast iron back, these free poles became nearly as strong when the armature was in contact with the regular poles, as the regular poles. We then in addition to the cast iron yoke inserted a small soft iron yoke about $\frac{3}{64}$ thick, this made some differance in the speed still there were free poles; We then took the magnet out of the Engine frame for testing, found that with the small soft iron back there was scarcely any free poles when the front armature was not in contact with the cores, this armature is $\frac{3}{32}$ thick, but when in connection the free poles were very strong perhaps they would attract with a force almost equal to the regular ones, by making the armature thicker the free poles became stronger If the yoke was increased in thickness the free poles became weaker and it is very probable that

if both the yoke cores and armature had the same mass of metal and all in good contact no magnetism or free poles could be detected but the moment the iron circuit, or perhaps we might call it the magnetic circuit was weakened by decreasing the mass of the iron at any one point free poles would appear at that point, hence to obtain the maximum power the mass of iron in the yoke should be so great as to offer but little resistance to the passage of the magnetism so as not to cause free poles, thus compelling the poles to go to the point of greatest R. those in front of the armature, and it may be found that a thin armature will increase this tendency by increasing the resistance We also discovered a Phenomenon, thus with a thick armature and back or yoke considerably thinner a nail was attracted only on opening and closing the circuit further tests should be given this and the armature & yoke proportions.

Oct 6th 1875, all night

Thos. A Edison
Chas. Batchelor
James Adams

Autographic Pen

No 3

Worked on pen all night - (model pen) found that cams gave vibrating pen too great a movement (ie) three times more movement than was necessary to puncture the paper, hence engine had to do more work, altered it so that it would give much less movement, There was a great improvement in the speed of the engine, but not enough to account for the unsatisfactory working of the pen, we tested

the spring contact also on setting the armature in various positions.

Chas Batchelor
James Adams

October 7th 1875

No 4 Autographic Pen

Went at model pen again, found that the trouble was principally in the back center screw, it was cupped too deep, and the magnet pulling the armature towards it made a great friction, not noticable when there was no magnetism, had a small center hole put in the screw, and the pen at once went perfectly satisfactory. Also took out the magnet wound with founder wire and rewound them with finer wire, perhaps three sizes smaller, then engine went still faster, and the pen appears to be the most satisfactory yet produced. Two inductorium cells do not work it satisfactory. on all nights =

Thos A Edison
Chas Batchelor
James Adams

Oct 8th 1875

No 5 Nitro-cellulose = Kid

The celluloid Co proxlin containing a considerable quantity of Chloride lime and perhaps some free SO_3 was found readily soluable in proxylic spirit, in the cold. even after so much proxlin or nitrocellulose had been added that it assumed the consistancy of dough. It would still continue to dissolve more.

Phenomenon after it is thus dissolved it is easily and entirely soluable in Water. a thin solution of which makes an excellent glue for fastening paper together, as the substance has an intense acid reaction. I am inclined to think that the proxylic spirit is turned into acetic acid which is an excellent solvent for proxlin. I tried to vulcanize it by adding flower of sulphur and heating it in an iron watch glass dish = failure — It does not mix with gutta percha dissolved in Carbon Bisulphide

Thos A Edison

Oct 8th 1875

No 6. Autographic Pen

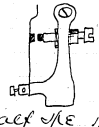
Our original pen was faulty in these respects, hard rubber was not a suitable material for the frame and the whole pen was too expensive to manufacture, no two pen acted or were alike some would go right off and make a much larger number of revolutions in one minute than others, and work on a spent battery when others did not.

We made a pen with an iron frame and it did not go well and for a time we thought the iron must have something to do with it but we have since found that it has no effect.

We made a frame of brass and new parts and found that it did not run as well as some of the old pens.

after considerable experimenting found following

1 The centres must be small,
2 The back centre must bottom thus
3 The front centre must be thus
4 Both centres and screws must be hardened steel
5 The wire on the magnets must be No instead of No..
6. The cam must be of steel
7. The cam clip must be of steel
8. The contact vibrating spring must have a piece of platina wire thus



9. The armature must be half the thickness of the keeper
10 The needle must have a very long taper, not blunt
11 The cam must not move the clip but very little sideways,
12 The needle must be soldered to rod
13. Centres must be very true to prevent armature from approaching magnets eccentrically
14. All wearing parts must have a looking glass burnish.

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15 The cam should vibrate the needle just enough to pass through the paper (ie) the length of this line 1.

October 14 1875

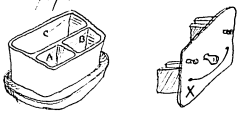
Thos A Edison
Chas Batchelor
James Adams

Batteries

No 7.

We have experienced considerable trouble in obtaining a suitable battery to run our Autographic pen. The French Grenet battery are easily tipped over and the rod which serves to raise and lower the zinc in the liquid becomes stuck in its holder by oxidation and by crystalization of salts. In order to obviate this objection we made a model of wood intending to make it of earthenware or glass like figure 2.

Fig 2



The appartments A and B for the battery and C for dripping when the cover X has been lifted up and turned around and the battery is not in use. We found that it was almost impossible to get the compartment jar made of earthenware, it contracts so much that the partition would seperate from the side, however a party in Trenton said he would try and make them for $1.25 each. We next went to the glass people found that the mould would cost $125.00 and the glass moulded with cost 25c per lb at lowest.

We then thought of making the cell shewn in fig. 1. of cast iron placing glass cells in A B and C. also of forming the cell out of sheet hard rubber by mould and hot water or oils.

Also of taking two Grenet Batteries and placing

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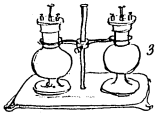
them on a stand as in fig 2

Fig 2



which brought in another idea of putting two glasses upon a stand (iron) as in fig. 3. and letting both the zincs and carbons out using a porous cell. The glasses set in the iron base 1 inch the carbons are copper plated and soldered to the connection pieces. The zincs have a screw cast on them all fastened to thick rubber disks which are in turn fasted to an arm connected to the upright rod. The battery is shewn in fig 3

Fig 3

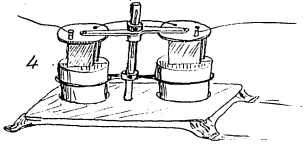


Fig 4

Fig 5

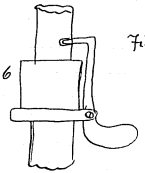


Fig 4 shews the porous cup fig 5 a catch for holding the elements out of the liquid. The arm carrying the elements is prevented from turning by a key seat in the upright in which a screw runs which can be used if necessary to hold the arm in any position in place of the catch shewn in fig 5

We propose to use electropoin of great strength in the porous pot.

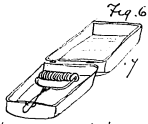
October 14 1875

Thos A Edison
Chas Batchelor
James Adams

No 8. Ink distributor

We find there is wanted some place whereby the ink for the autographic press may be put on the roller This is shown in fig. 6.

Fig. 6.



The bottom on which the ink is spread is an inch board with its grain at right angles to the handle of the roller so that should it warp it will not prevent even distribution

October 14. 1876.

Thos A Edison
Chas Batchelor
James Adams

No 9. Batteries

Put up two 1½ ordinary electropoin batteries. with porous cell and ordinary fluid. Started new iron back pen running at 7.30. PM Oct 14th at 8 AM Oct 15 it was running as fast as when started and writes as well. no perceptible darkening of the fluid in porous cells, but found that the needle which is placed in a slot in rod works loose. on Oct 15 6 PM Engine still running fluid apparently as yellow as ever. 8 PM. Engine running good and strong 1 cell containing 1½ carbon turned black No 1 Carbon cell still yellow Oct 16 9 am Engine running very slow both cells black and run down

October 16 1875

Thos A Edison
Chas Batchelor

No 10 Polarization

Solutions and substances to depolarize negative element of the Hydrogen (Wird)

Solution Sal Ammoniac and small quantity of Sesquichloride of Iron on No 4 strap of a Bradley Tangent galvanometer First closing 20° in one minute 15° shaken moderately goes to 35° shaken more 40° more 45° shaken violently needle goes to 90° - Carbon & Zinc electrodes, French = Electrodes placed in Chloride of Calcium, on closing needle goes to 10° shaking makes no difference = Electrodes soaked in Chloride Calcium then dipped in strong NO_3 to precipitate the gypsum on Carbon, doesn't apparently do it. on closing, needle goes to 50° in 1 minute 30° shaken violently goes to 52° =

Zinc covered with Castor Oil and immersed in a Solution of Ferric Sesquichloride and Ammonic Chloride needle goes to 18 in one minute goes to 19° in 2 minutes 20° 3 minute 21° in 5 minutes needle goes to 23° when battery well shaken stands at 30° then goes back and stops at 26½° shaken again goes to 32° then goes back to 28° =

Both Zinc and Carbon covered with castor oil on closing needle stands at 30° in one minute stands at 27 shaken violently goes to 45°

Z covered with Olive Oil. in same solution as above on closing 20° in 10 seconds goes down to 15° when shaken violently goes to 40°

Zinc coated with Balsam Fir needle on closing stands at 20° one minute goes to 6° shaken violently goes to 35° then drops to 6°.

Zinc coated with Cod Liver Oil when put on zinc turns white on closing needle stands 30° in 10 seconds 9° shaken goes to 40°.

Zinc coated with Gum Arabic, closed 30° goes to 17° in five seconds

Zinc covered with Grape Sugar closed 30° in 10 seconds goes to 20° two minutes 18°

Zinc covered with silicate of Soda, (Water glass) closing 40° 20 seconds goes to 20° Shaken needle goes to 60 then drops in 20 seconds to 20°.

Zinc covered with Collodion, on closing needle stands 45° goes to 20° on shaking seconds on 1 minute 18° and stands permanently at 17½°

Zinc and Carbon Covered with Collodion. on Carbon there is rubbed in the Collodion Black oxide of Manganese (powd) on closing 50° in 30 seconds 30° stops permanent at 29.

October 16th.

Thos A Edison
Chas Batchelor
James Adams

No 11 **Battery Fluids**

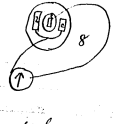
No 1½ Carbon alls zincs unamalgamated

No. 1. $KOCrO_3$ 8 parts SO_3 15 parts HO 20 parts ordinary red fluid closing at 9.40 PM 30° See table page 11.

October 17th 1875

Thos A Edison

No 12 **Polarization**



An extra carbon is placed in the outside solution and connected to the zinc thus forming a battery. these are used as one pole the Carbon in the porous pot as the other, When you break the circuit between the Carbon in the outside from the zinc Galvanometer goes up 1° by putting Extra Carbon inside porous cell with the other carbon but not touching it needle runs from 82 to 43

See Vol 5 p 4.

October 19 1875.

Thos A Edison
Chas Batchelor
James Adams

No 13

Battery Fluids

No 1½ Zinc & Carbon 50 3 in outside unamalgamated

Bradley Gal = 50 op - 20 R No 4
Tangent

No	Formula	Closing	Op	Sp	Op	Sp	Op	Sp	Op	Sp	Time	Remarks
1	$NiCr_2O_7$ = 5 parts SO_3 15 parts HO 20 parts ordinary electropoion fluid	PM 9.40	30°	3.27	20°	9.33	13½				Hays 5	
2	$KONO_3$ = 5 parts SO_3 15 parts HO 20 parts	9.20	0°	2.25	37½	5.19	23°				1.24	17½
3	$KOCrO_3$ = 5 parts NO_5 15 parts HO 20 parts ordinary	9.14	28°	4.18	20°	4.57	21½				1.30	10½
4	$KOCrO_3$ = 5 parts NO_5 15 parts SO_3 15 parts HO 20 parts	10.20	30°	5.30	9½	9.30	5.33	43	1.40	17½		
5	No 12 5 parts SO_3 15 parts 20 parts ordinary red fluid	10.03	30	5.30	13½	9.30	5.33	13½				
6	Ce Pickle process 5 parts HO 2 parts 1 m 21 2 m 27 3 m 27 3 minutes 47	1.25	27	2.33	13½	3.30	13½		1.34	14		
7	Zinc management TK 5 parts SO_3 15 parts HO 20 parts	1.25	24	2.34	24	4.45	1°		1.40	3		
8	$KOCrO_3$ 5 parts SO_3 15 parts HO 20 parts	1.14	17½	3 m	41	4½	12°	4.46	11°		1.40	11½
9	$KOCrO_3$ 5 parts SO_3 15 parts $NaCl$ 5 parts 1 m 42½ 1 m 42 3 m 41	1.34	25°	3 m	25°						1.40	13½
10	Bichromate K 5 parts $CaONO_3$ 5 parts HO 20 parts 1 m 34 1 m 42 3 m 47	1.35	40°	4.46	27°						1.44	3
11	Chromate K 5 parts SO_3 15 parts HO 20 parts 1 m 40 1 m 42 3 m 47	1.40	25°	4.47	10°						1.46	19¾
12	Bichromate 5 parts SO_3 15 parts HO 20 parts 8° 1 m 9 3 m 10½	2.20	10½	4.43	38½						1.48	21
13	$KOCrO_3$ 5 parts SO_3 15 parts HO 20 parts 22 1 m 25½ 3 m 25½	2.11	25½	4.30	20°						1.49	22
14	$KOCrO_3$ 5 parts SO_3 15 parts HO 20 parts 54 1 m 52 3 m 50½	3.59	50½	5.30	27°						1.53	26
15	HO_2 85° one minute 56 1 m 56 3 m 3½	7.17	3°	8.35	16°						1.54	16
16	$KOCrO_3$ 10 parts SO_3 5 parts HO 20 parts 45° 1 min 45° 3 min 44	3.55	96°	5.20	60°						1.59	10
17	$KONO_3$ = 10 parts SO_3 15 parts HO 10 parts	4.15	44°								2.44	9
		5.30	53°								1.54.44	1.30 17

Oct 17

Oct 18 1875

Accepted

Thos A Edison
Chas Batchelor
James Adams

Bradley Gal straps No 74 — Battery Fluids — 1½ Carbon, = Telegraph Cells

October 19th 1878

No									
1	$KONO_3$ 10 parts	SO_3 18 parts	HO. 20 parts.						
2	Same as No 1.								
3	Ordinary Electropoin Q.S.								
4	$KONO_3$ 8 oz	SO_3 1 lb	HO 3 lbs weight						
5	$KONO_3$ 5 oz	SO_3 8 oz	4 oz	HO 10 oz					
6	Same as 5 except KO_3 8 oz								
7	$KONO_3$ 1½ oz	$KOCrO_3$ 1½ oz	SO_3 7½ oz	HO 20 oz					
8	Same as 7 except SO_3 10 oz								
9	" " 8 with 1 oz more each $KONO_3$ + CrO_3								

am 11.15	60½	313	42	
am 11.16	62	316	52	am 333 45½
am 11.30	58	320	44	am 335 30
am 11.35	54			337 26½
am 11.37	29			338 25½
255	59			338 47½
310	52			am 6.00 27
341	52			601 23
am 4.00	52			550 33

No 3 was probably not well short circuited.
No 1 Had defective porous cell, made a difference of 10° found out by changing Z. C. Fluids etc.
No 4 polarizes 10 degrees in 3 minutes
No 5 " 3 degrees in 3 minutes
No 7 " 3 " in 4 "
No 8 on closing 20° in one minute 30 in two minutes 38 in 3 minutes 40, changed porous cell went to 50 + mm 52
Found that a dry old porous pot would give full strength in 5 minutes. The pots vary greatly in resistance which is especially noticeable on very short circuits =
No 1 showed have more HO The salt Crystalize on the Carbon pole besides an image in bottom porous pot

All night

Thos A Edison
Chas Batchelor
James Adams

Plumbing Process

Use the autographic pen & punctate the lots in the paper to form the drawing, writing etc. Wet the paper, or use paper previously made impervious to moisture by varnish or shellac or other material, or tin foil by other metallic foil. Lay the punctated sheet of tin foil or perforated paper upon a polished surface. Being a frame work down into it & pass in liquid plaster of Paris, pouring the same upon it & rub the weight of the extra plaster of Paris will force it through the holes. After it is thoroughly dry take the paper & separate the paper from it either by pulling off or dissolving in H_2O_2 or burning. Engraved Shellac, rolling wax or any substance that can be fused upon the paper then the paper in a liquid or semi-liquid state & hardens by time heat or other means will do.

Note the plate is dry it is coated with plumbago or other conducting substance. Wet by electrotypers & place a non-conducting substance a conducting surface, & then put on a blasting fork & electrotype on the usual manner, & it may be done in 5 minutes from chisel.

The punctated sheet done by the autographic pen may be used like a broken stencil machine in stereotyping, the stencil being placed on a metal & the metal forced into it, the pressure of the wax metal at the top of the metal covering to force it through every punctured hole to the smooth surface of metal underneath, when the metal is removed it is taken out the paper & stripped from it & blocked, it is then ready for printing on the usual manner.

The punctated paper prevents any metal & hands effects of glue on it by friend Edison

hardenings that it did not go through the holes owing to them being closed up by the water swelling the paper

We tried pouring lead on a stencil but it did not go through the holes, we then poured through a funnel shaped tube like Fig 1 so that we could get a body of metal to press it in. In this manner we could see the shape of the letters on the lead & there is no doubt that with care & lots of pressure we could get it perfect. We tried putting stencil paper on flat plate of Zn. & fastening down with beeswax, then making a beeswax embankment around the writing & pouring in Hg but with little success as the holes seem to be too small for it to get through

Fig 1

9

We also tried copperplating through the holes to get a raised surface on the metal to print from

We tried writing with common ink & shaking plaster of paris on it to form a hard insoluble substance to print from. it raises it up pretty high but it is probably no good

Paraffine apparently goes through the holes & we took a good print from it

Oct. 19th 1875

Thos A. Edison
Chas. Batchelor
James Adams

No 16 Batteries

In order to dispense with porous cell we tried the following:-

10

X is a glass cell filled with electroporion.
N is an ordinary battery jar in which is H_2O as high as ½ of an inch above the top of the electroporion jar. The theory being that the ½ of an inch of H_2O above the electroporion in the glass cell X will serve as a conductor between the outside & inside solutions dispensing with a porous cell & that the rate of diffusion will be so slow that

that the electroporion will be exhausted before enough SO_3 comes over into the outside solution to attack the Zn strongly. Jar used for outside 1½ carbon, 2½ (cut battery) cell for X put on at 11 40 PM

Thos A. Edison
Chas Batchelor
James Adams

Oct. 19th 1875

No 17 Mining Ores.

To ascertain if a vein of smelting (ie) earthen ores is a pocket, connect an earth plate making good connection with the general earth to a telegraph wire of known resistance the end of the wire being at the mouth of the mine, which mouth must be soft earth all round, the wire is run into one end of a test battery thence to a galvanometer & wheatstone bridge thence to a large plate (of given size previously tested together with other plate & wire in general earth) inserted in the body of ore in the vein By a little experience the fact that the vein is or is not a pocket can be determined also its size & richness. As the salts or oxides of the metals are better conductors than ordinary earth of the vein is a pocket the body of ore might be determined by charging the whole body statically or by secondary battery action.

Of course in these tests the condition of the country geological formation, hygroscopic condition, the nature of rock & ore must be taken into consideration as well as many electrical points.

In a Quartz vein with walls of rock containing little or no moisture the ore being one mass of stained rock (ie) finely divided, the test can be made by charge, condenser, etc.

The H_2O oozing from the rocks of suspected localities might be tested with spectroscope to detect soluble chlorides of gold & silver salts.

the different parts of the rock showing different quantities from which the lay of the vein may be got by calculation.

We find by experiment that if porous earthenware is held on the tongue it soon clears it of all H_2O & the force of capillary attraction locks the tongue to it so that it is painful to separate it.

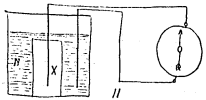
This principle may be useful in mining ores in the following manner:- take earthen ore & roast it to turn the silver into a hygroscopic salt; it is then exposed to the air till it is moist, & afterwards thrown onto large trays or cylinders of porous earthenware when the silver salt will stick by capillary attraction & the sand & silica will not

Oct 19th 1875
12 P.M. Midnight

Thos. A. Edison
Chas Batchelor
James Adams

No 18 Batteries

In experiment on batteries Page 14 we found at 2.25 AM Oct 20th that scarcely any of the electropoion has come over from X into N showing that this plan is a success as far as mixing of fluids is concerned.



We now put a carbon & zinc & found it only gave 7° on Nat of Bradley galv, showing a great deal of resistance in the fluid that connects X & N

the Zn is attacked fiercely at a point in a line with top of X showing that SO_3 is coming over.

Oct 20th 2.25 AM

Thos A. Edison
Chas Batchelor
James Adams

No 19 Porous cups

Tried plaster of paris to make porous cells, can make very beautiful ones but as yet do not know

whether they are porous enough. Hardened plaster of paris which had only been set 1 hour softens immediately if dipped in $SO_3 + H_2O$ that dissolves paper. Plaster of paris which had been hardened 2 hours & had originally les H_2O only softened slightly, it is probable that if thoroughly set say 24 hours $SO_3 + H_2O$ would not have any effect. the SO_3 acts by depriving the $CaSO_3 + H_2O$ of its H_2O which chemically combined with the $CaSO_3$ when mixed

We attempted this morning to make porous cups from some clay from Long Island which was supposed to be capable of being used for Portland cement. it works very well & we may perhaps succeed in baking it properly

Oct 20th 5 A.M. 1875

Thos A. Edison
Chas Batchelor
James Adams

No 20 Mining

On a zinc plate moistened slightly crystals of $CuOSO_3$ stick quite strongly, the Zn reducing the $CuOSO_3$ to $ZnOSO_3$ & metallic copper sticking it.

Hy-Silicic Acid mixed with Pt Cl. placed on a Zn plate does not stick

Tried wetting paper with H_2S & putting on Pt Cl mixed with Hy Silicic Acid. no good

Ditto with Becberin & Na Sil.	no good.
Ditto with Mn SO_3 & Na Sil	no good
Ditto with Hg Bichl. & Na Sil	no good
Ditto with Na Suphs Cuid. & Na Sil	no good
Ditto with KO, Acitate of Alumum & Na Sil	no good
Ditto with Alumum Cl & Na Sil	no good
Ditto with KO.	no good

We tried the following experiments, mixed with some dirt off street, sand, etc a small quantity of Ca carb. then put it under the prime conductor of a plate glass machine & all of the carbonate of Calcium was separated from the sand adhering to

it, the sand was attracted but of course fell off. Also tried Sulphide of Cadmium mixed with NaCl both powdered. The cadmium sulphide was readily separated from the NaCl, we proved it by testing what stuck & what fell off with Ag NO3. That attracted shewing but faint trace of NaCl. while what remained gave dense white pp. of AgCl.

We tried the regular Utah ores powdering it & attracting with machine. the fine stuff attracted was acidulated with HCl & chloridize the Ag filtered & dissolved the AgCl in Na Hyp: sulphite & precipitated with HCl. This experiment was a failure as the addition of HCl & Hyp: Na precipitated S & disguised the AgCl.

Oct 21st 11 PM 1875

Thos A Edison
Chas Batchelor.
James Adams

No 21 Mining Ores

Tried dirt, brass filings & fusible metal dissolved in hot water, idea being that the fusible metal would act as an amalgamator instead of Hg. It was not a complete success the brass filings stuck to the surface very thick & free from earthy matter, but on breaking the globule of fusible metal very little brass was found inside

Oct 22nd 12 midnight 1875

Thos A Edison
Chas Batchelor

22. Battery Fluids.

NO5	1 Part,	SO3	3 Parts,	8.45 PM.	40°,	2.15 AM,	21
Pb NO5	½ oz,	NO5	4 oz,	SO3	4 oz, 9 PM,	07,	2.15 AM. 14
NH4Cl. nitride,	H2O inside	Hop Ac.	2 Stick,	9.25 PM,	21	2.15 AM	9

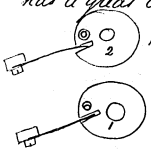
Oct 22nd 1875

Chas Batchelor
James Adams

23 Domestic Telegraphy.

On Domestic Recorder I noticed a very thick black oxide formed which prevented the marks. Paper was ordinary Pyrogallic solution. When rubbed off with fine emery paper the nickel went off with it & it looked as if had oxidized the nickel or it had been dissolved at that point. When the escape wheels are not our time in signal box, the signal is irregular thus for box 15 I have got — · ····· , — · — ····
— · — ·· · — · ···· all inside of 10 calls

I find also the setting of the flat spring on segment has a great deal to do with plain & even signalling, when the segment is going up the spring & pin ought to rest as in fig 1 & when it is coming down it ought to be as in fig 2 It must be perfectly free at all times & not clamped sideways nor so large as to fill the slot.



Oct 22nd 1875

Chas Batchelor.
James Adams

24 Autographic Press Roller.

We find the best way to turn rollers of felt for press is to have a tool in slide rest & take a good heavy cut backwards & then let the same cut cut the opposite direction to smooth it up. Then dress it up with sand paper (coarse) on a perfectly straight surface.

They can be rasped down by a regular wood rasp very quick & good but it then depends on the man to make good straight rollers whilst the other making it by tools must make it right

Nov 1st 1875

Chas Batchelor
James Adams

25 Celluloid

Took SO_3 24 „ NO_5 fuming 6 „ H_2O 4 „ & mixed & let them run down to 140° & put a little in a flat dish, then took brown tissue paper cut in strips & then with 2 glass rods kept turning it in the air to keep it cool after saturating it, threw it in large quantities of cold water violently shaking all the time to prevent heating. In this way can peroxidize a large amount with a minimum quantity of acid after washing thoroughly neutralized it with NH_4 & washed & dried it. This was very combustible but insoluble in our alcohol. Probably it has got too much water in it. We found that by addition of camphor it would dissolve also on addition of Acetone, Wintergreen Oil, oil of Myrbane & Spruce & a few other of the essentials Gum Obalanum doesn't seem to work. Thymol dont seem to work. Spruce + Myrbane seem to be the best the latter the better one of the two though not certain. We think the tissue paper ought to be pulped to get it to dissolve good. We called this No 1 sample & commenced to make some more Sample No 2 was wet with acid sent in the form of spray from a reservoir & did not work well it seemed to be eaten up inside & like India rubber out 3 was oiled tissue paper worked in the same manner as No 1

4 was waste in the same manner.

5 We boiled some sawdust in KO & afterwards treated as No 1. 6 was wood paper in the same manner

We now took No 1 (as none of these were soluble under the ordinary conditions) as being the best & proceeded to find a solvent for it.

We found that NH_4I + Alcohol was a cold solvent

$ZnCl$ + Alcohol good hot

Sulphocyanate of Potash + Alcohol partial hot,

NaI good hot

Ebre Acid + Alcohol partial but not much.

We bottled all these to try again

Nov 5th 1875

Chas Batchelor
James Adams

26 Discovery

Experiment; Subsulphate Iron „ & Sulpho-Carbolate of Lime in Alcohol when boiled gives a beautiful purple color, Sub Fe SO_3 ~~alone~~ in Alcohol with Sulphocarbolate of Lime will do it but not so well. There are certain proportions to be used Fe_2SO_3 does not work, Alcoholic tincture of Iron (Mus) gives very light violet tinge.

Nov 6th 1875

Chas Batchelor
James Adams

27 Celluloid

In experimenting on solvents for paper peroxidized by solution in No 25 page 20. we found that

Oil of Myrbane + Alcohol was perfect solvent cold.

Oil of Pennyroyal + Alcohol was good hot

Oil of Sassafras + Alcohol was good hot

Menispermum + alcohol was good hot

Bromide of Sodium + Alcohol good hot

Sulphocarbolate of Soda + Alcohol good hot

Ammonium Rhodan + Alcohol hot

Chlorate of Copper + Alcohol hot

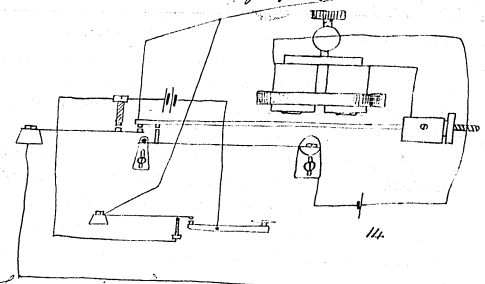
Chlorate of Lithium + Alcohol good hot

Bichloride of Mercury + Alcohol hot

were all solvents as we have qualified them

Chas Batchelor
James Adams

28 Acoustic Telegraphy.

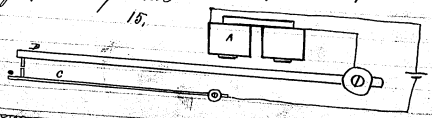


14.

This device has a vibrating rod always vibrated by magnet & local battery with great amplitude & spring. The scheme and works a duplex contact or throwing in & out the battery without breaking the continuity of the circuit & connected in circuit as shewn. The duplex key is used to throw the battery entirely out of circuit which would otherwise be constantly be thrown in & out by the duplex springs in the vibrating bar, not breaking the continuity of the circuit allows us to use a number of separate batteries it also allows the wire to discharge to earth & allows of a condenser at the receiver to augment, quicken & sharpen the waves of current; it also allows us to transmit a greater number of messages, for by Gray's plan 6 message would keep the line mostly closed & of course the sounder to work badly.

We find that the arrangement we made last night gives a perfectly even break with great amplitude of spring & positive position

15.



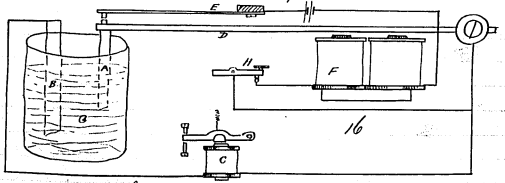
B $\frac{1}{8}$ Stubbs steel wire, C $\frac{1}{32}$ stubbs steel wire. A an ordinary 20 ohm magnet, 2 cells of Carbon battery. 9/16 of an inch motion at the extreme end of bar B perfectly even on closing for a dot. The bar B vibrates in an arc about $\frac{1}{16}$. On making a dash at ordinary morse speed the vibrations reach at least $\frac{1}{32}$ of an inch on making an I at the rate of 15 words per minute it reaches $\frac{1}{16}$ of an inch. of course these extreme limits are not required. A similar apparatus to the above properly adjusted placed in circuit & operated by the breaks from the transmitting instrument answered promptly & vibrated about $\frac{1}{32}$ & we could send at the rate of 7 words per minute but our contact breaker is inferior Batchelor is now making new spring device.

5.35 AM

Nov. 16 1875.

Chas Batchelor
Jas Adams

(29) Depolarization of Batteries



16

We made this apparatus. A is a platina electrode fastened to a vibrating arm of the vibrating mechanism O.D.H. B is a zinc electrode & forms part of the battery of which A is the other pole. The solution is placed in C & the sounder closes, as the battery polarizes, the sounder opens, & we want to find a solution that will close the sounder C quickest after the key H is depressed & the vibrating arm started.

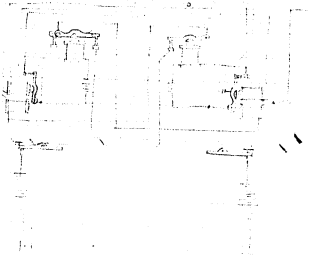
Sesquichloride of Iron & Chloride of Ammonium closes after a few seconds.

Sulphuret Sodium, Chloride of Ammonia & Chloride of Mercury closes after a few Seconds.
Chloride of Ammonia & Ferridcyanide of Potassium closes very quick.
Nov 17th 1875

Chas Batchelor
James Adams

(30) Automatic Repeater

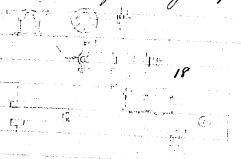
We set up the following idea of Edisons for repeating nothing but ordinary relays & sounders required.



14

(31) Acoustic Telegraphy.

Tried the following experiment -



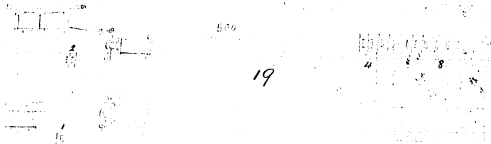
18

N is a secondary battery. The slight closing of X of tuning fork against C vibrates the relay badly but each dot from relay lever & local circuit charges the secondary battery N & closes sounder. When open the secondary N discharges in sounder until next dot & keeps it closed.
Nov 21st 1875

Chas Batchelor.
James Adams

(32) Quadruplex Morse telegraphy

The following experiment whereby increased & decreased currents are made to work a common backpoint relay properly & reversed currents made to work also the ordinary front point relay.

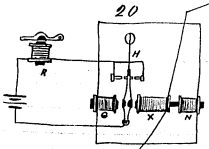


19

This works splendidly & would answer well for a Quadruplex.
Nov. 21st 1875

Chas Batchelor.
James Adams

(33)

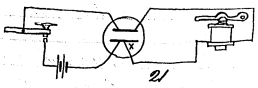


20

This works slow. The sounder works right but if you go fast sounder closes permanently. The induction from N closes C for an instant when X opens keeps R closed X close again keeping R closed
Nov 21st 1875

Chas Batchelor
James Adams

34. Acoustic Telegraphy

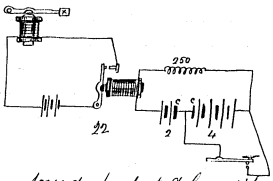


21

This makes a first class sounder dots far apart keeps sounder closed. The longer the dots the greater time sounder stays closed. Good for working by vibration.
Nov. 21 1875

Chas Batchelor.

35 Quadruplex Telegraphy.



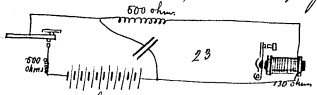
The weight at x dont work well but on closing relay the jump makes the down stroke on the sounder & on opening the other jump makes the back stroke. The writing sounds perfect & beautiful without the necessity of the sounder lever touching the backpoint. This dispenses with the polarized relay in the Quadruplex.

Nov 21st 1875

Chas. Batchelor
Jas. Adams

(36) Morse Telegraphy

With or without resistance; putting a condenser in makes relay work sharp on an adjustment that without it would cause the relay to stick altogether (ie) about 2 secs after opening an ordinary local circuit will say open & no route for relay discharge. Apparently the Condenser sends a reverse charge through relay & kills the residual magnetism.

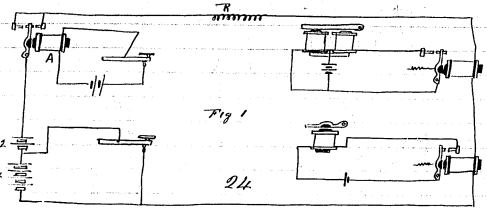


Nov. 21st 1875

Chas Batchelor
James Adams

34 Quadruplex Telegraphy.

The experiment of Fig 1 works perfectly if magnet of A & spring A is so adjusted that it opens & closes in equal time; relay to open & close twice each forward & backward movement of lever of A & all down stroke on sounder works beautifull. The total breakage does not open C so bad as reversals. Shunting B with a condenser makes it worse.



We tried a front point relay at C with total breaks disguised by shunting relay also by shunting sounder & use of secondary battery but breaks show too plain & we must use a polarized relay.

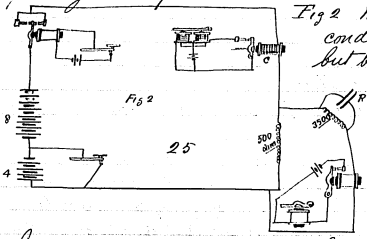


Fig 2 with 1000 ohms in condensers R not good but better than if no resistance or condenser used but when it is made 2500 the dead open relay works perfectly splendid & the backpoint relay works better than when reversed currents are used altogether this arrangement is a grand success.

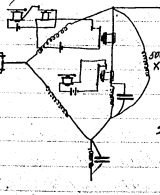
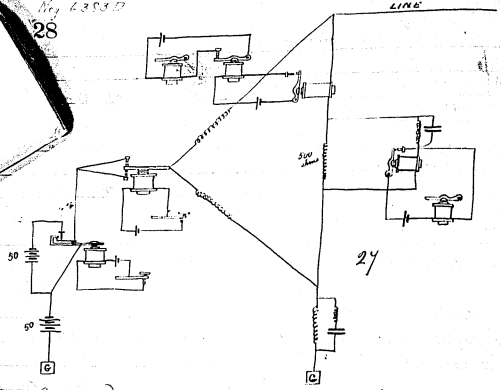


Fig 3 is another arrangement that works splendidly; it weakens back points but makes it work equally as well. Breaking circuit shunt & turns up dead open relay as there is no route for the condenser.

Fig 4 shows one end of the Quadruplex on this new principle.

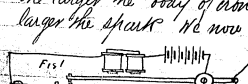


Nov 22nd 1875

Chas Batchelor
James Adams

(38) A New Force.

In experimenting with a vibrator magnet consisting of a bar of Stubbs steel actuated at one end & made to vibrate by means of a magnet we noticed a spark coming from the core of the magnet; this we have noticed often in relays, in Stock printers when there were a little iron filings between the armature & core & more often in our new electric pen & we have always come to the conclusion that it was caused by strong induction, But when we noticed it on this vibrator it seemed so strong that it struck us forcibly there might be something more than induction. We now found that if we touched any metallic part of the vibrator or magnet we got the spark. The larger the body of iron touched to the vibrator the larger the spark. We now connected a wire to x the end of the vibrating rod & we found we could get a spark from it by touching a piece of iron to it & one of the most curious phenomena is that if you turn the wire round on itself & let the point



of the wire touch any other portion of itself you get a spark. By connecting x to the gas pipe we drew sparks from the gas pipes in any part of the room by drawing an iron wire over the brass jet of the cock. This is simply wonderful & a good proof that the cause of the sparks is a true unknown force.

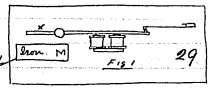
J A Adams

Nov 22nd 1875

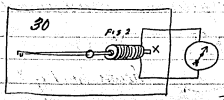
Chas Batchelor
James Adams

(39) New Force.

The following very curious result was obtained with it. The vibrator shown in Fig 1 (Art 38) & battery were placed on insulated stands, & a wire connected to X (tried both copper & iron) carried over to the stove about 20 feet distant. when the end of the wire was rubbed on the stove it gave an splendid sparks, when permanently connected to the stove sparks could be drawn from the stove by a piece of wire held in the hand. the point X of vibrator was now connected to the gas pipe & still the sparks could be drawn from the stove.



Whilst the rod was vibrating an iron piece M weighing about 8 pounds was placed near to X but not touching it in any way or connected to it except by the wood of the base & sparks could be drawn from M with a piece of wire as at W. This would have led to be inferred that that sparks can be drawn from iron bodies in a magnetic field, & that these sparks or force can be transmitted over metallic conductors & do not follow the laws of either voltaic or static electricity.

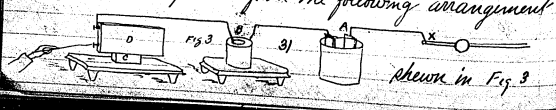


Put a coil of wire over the end of rod X & passed the ends of spool through galvanometer without affecting it in any way tried a 6 ohm spool & a 200 ohm

We now tried all the metals touching each one in turn to the point X with

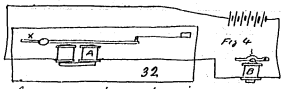
Antimony we got a spark
Lead " " " "
Iron " " " " very good
Carbon " " " " more actinic
Copper we got a spark
Manganese (peroxide) we got a spark.
Platinum we got a spark.
Mercury we got a spark
Tin we got a spark
Palladium we got a spark
Manganese we got a spark very poor
Potassium we got a spark green
Sodium we got a spark
Tellurium we got a spark also a strong & disgusting smell of garlic
Boron we got no sparks
Aluminium we got a spark.
Zinc we got a spark
Cadmium we got a spark good scintillates
Bismuth we got a spark scintillates
Nickel we got a spark
Gold we got a spark
Rhodium we got a spark good
Cobalt we got a spark good
Arsenic we got a spark
Selenium we got no sparks
Thallium we got a spark magnificent green color very actinic little scintillation
Indium we got a spark
Silver we got a spark magnificent green

When standing on an insulated stand we can draw sparks from the following arrangement



shewn in Fig. 3

X is the end of vibrator which is insulated as well as battery A is a secondary battery B is a 200 ohm coil of copper wire, C is a block of iron, & D is a condenser all well insulated except A which is glass & stands right on table.

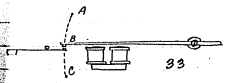


Another magnet B was now put in circuit with the vibrator magnet A & well insulated, a large piece of iron well insulated from everything was now placed 3 inches from A & another the same distance from B & sparks were drawn from both.

Nov. 23 1875 Chas Batchelor
Jas Adams

40 An Optical Delusion

When a vibrator is working & giving a bright spark a curious phenomenon may be noticed. Take two fixed points one at each side of vibrator & about three inches from points & look first at one point & then the other in quick succession & a line of small dots or sparks will be seen on the



periphery of a circle that would be described if the length of the vibrating rod were taken as a radius. If you look across slow towards A the line from B to C will only be seen & as you look towards C the line from B to A but if you look very quick the whole line from A to C can be seen

J. A. Edison
Nov 23 1875 Chas Batchelor.

James Adams

(41) New Force.

We tried our new force over a telegraph wire running from Newark to New Brunswick, thence to New York & back to Newark. We connected X of vibrator shewn in previous articles to the end of line & obtained sparks from the other end of wire with a piece of iron wire held in the hand, showing that this force can be transmitted over long telegraph wires. We then grounded the wire where the vibrator is connected to it & still obtained a spark, showing that this force may be transmitted over uninsulated iron wires buried in the earth for instance the sheathing of the Atlantic Cable.

When we take a spark from the end of the rod X it is much less than when we connect the gas pipe system to it

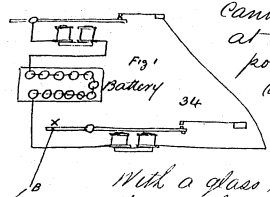
We tried passing the force through water one pole being iron wire connected to vibrator X & the other to gas pipe but got nothing noticeable. Tried solution of Alcoholic Sesquichloride of Iron. Also solution of Protochloride of Iron also a solution of Nitric Acid with no result. Tried Gen. of the organics, Nix with Nitric Acid Nix, Camphor floating in water, Nix. Tried piece of Ferrocyanide of Potassium in Protochloride of Iron, Nix. Tried connecting a large Iron plate weighing 80 lb with X by adhesion, Nix also tried connecting gas pipe for same purpose, Nix.

We found that two iron wires stick together quite strongly probably due to the effect of the spark as the same thing occurs with an electric spark.

We shunted the vibrator with 3 ohms & could get no spark as it circulated in form of Inductive Electricity but could get spark when there was 20 ohms in shunt

By increasing the battery from 8 to 12 cells

we get a spark when the vibrating magnet is shunted with 3 ohms.

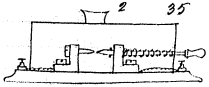


Cannot taste the least shock at A or B yet between carbon points the spark is very vivid as will be seen from Fig 1. X has no connection with anything

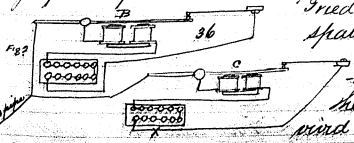
With a glass rod four feet long well rubbed with a piece of silk over a hot stove, with a piece of battery carbon secured to one end we received vivid sparks into the carbon when the other end was held in the hand with the handkerchief, yet the Galvanometer, chemical paper, the sense of shock in the tongue, or a Gold leaf electroscope which would diverge at two feet from an 1/2 inch spark plate glass machine were not affected in the least by it

A piece of coal held to the wire shewed faint sparks.

We had a box made thus:



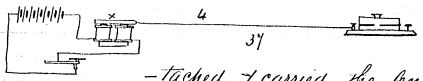
whereby 2 points could be brought together within a dark box provided with an eye piece The points were iron & we found the sparks were very irregular after testing some time two lead pencils were found more regular & pay much more vivid, we then substituted the graphite points instead of iron



Tried Fig 2 but the sparks were not so vivid. We then reversed battery X & the sparks were more vivid but not so great

as when B was used alone

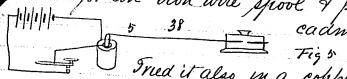
We now found that when we had box in circuit & a magnet operated by a key it would operate as well as a vibrator & with a piece of iron laid on cores at X Fig 3 & the wire at-



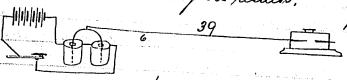
-tached & carried the length of the table into the box we could get the spark every time we opened the key. We tried different metals at X with the following result:—

Iron at X very good
Gold at X good
Brass at X good
Antimony at X very good
Carbon at X very good
Electropoion fluid at X very good
Manganese at X good
Nickel at X good
Copper at X very good
A piece of Coal at X good
Cadmium at X very good in fact Iron & Cadmium surpass all others in this respect

We got an iron wire spool & placed a piece of cadmium inside as in Fig 5 with very good result.



Tried it also in a copper spool of 6 ohms resistance with good results.



We took a piece of No16 copper wire bent in form of a horse-

-shoe & placed it in two spools as in fig 6 & get the spark when the spools are connected so as to give no magnetism we get spark just the same As a magnet having a resistance of about twenty five ohms connected to make no magnetism & placed in a circuit of 10.000 ohms with 20 cells of

1½ Electropoion battery sparks were obtained when the ends of the wire running to the box containing the Graphite points was held across the poles of the magnet by the finger

With 2 ohm spools with horse shoe copper wire put in 15 ohms resistance kills the spark.

With a 200 ohm magnet connected to give no magnetism, but which did give a little, we got spark on 10000 ohms good.

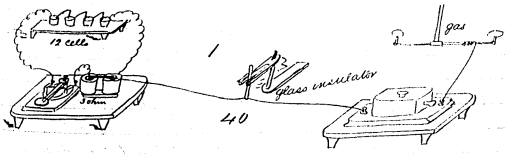
It appears that when the spools are connected to give no magnetism the electricity goes off into this new force and this same magnet I get it with only 12 cells battery & the magnet does not attract a fine iron wire suspended by a thread.

Nov 24th 1875

Jas Ewing
Chas Batchelor
Jas Adams

(42) New Force.

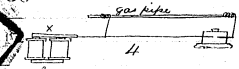
Started experiments in the following manner



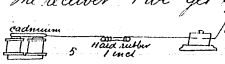
Of course we get the spark splendid with a piece of iron across the spools.

With magnet as in 2 weak spark. A is a 200 ohm magnet. B a 6 ohm spool with an iron core placed in & the two ends of 6 ohm spool together with the core connected to line.

The 200 ohm magnet closed on top with an armature & then the iron laid on that very good.



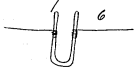
A piece of Cadmium at x & the line fastened to gas pipe on each side of the receiver & we get sparks just same.



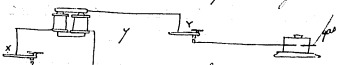
With an inch of Hard rubber in line we get sparks at intervals

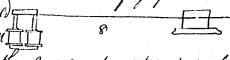
We then put a piece of glass in place of rubber & we got sparks at intervals

We put in a piece of glass that was bent as in 6 & we got sparks at intervals

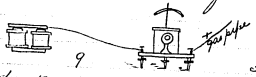


By closing x & working Y we could get no sparks when fixed as in fig 7. With the cores lengthened as in fig 8 & the cadmium placed on top of them & the magnet actuated by 3 cells of battery we could get sparks at times faintly.





We tried cores 6½ inches long in magnet shown in 8 & laid cadmium on top & got sparks just as brilliant as if on short cores



With mirror Galvanometer made of copper wire of 3000 ohms resistance, director very weak & near top scale 2½ feet off could not get the slightest movement, but by connecting one end of our graphite pencil box & x we got brilliant sparks inside.

With the cadmium bar stood up between the spools no result. With the cadmium bar placed across the spools in between cores no result.

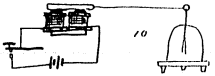
We put an Epinus condenser in circuit & get a splendid spark when both plates are in contact & weaker ones as they recede when both brass plates are six inches away from each other we get good sparks.

We placed the cadmium in local circuit & part of it with no result.

One of Ridder's Magneto Electric machines had both handles connected together & a wire taken from them to the pencils & got a good spark

When a six inch brass disc was placed on the poles of magnet & the cadmium laid on it that we get a good spark

When 30 inches of glass rod made part of line no sparks was visible



A Gold leaf electroscope that diverges its leaves 3 feet away from a common old fashioned plate glass machine gave no indications of 'Etheric force'

We tried to obtain Etherodes between which the spark will be more vivid than between graphite points. we fixed as in 11

x is a plate covered with tin foil.

Sesquioxide lead no good

Iodide lead more brilliant than on tin foil this would probably be good if hard pressed in to a pencil. We now discarded tin foil plate & used two lead pencil points thus

Sulphuret Antimony no spark

Spongy platinum spark in good.

Nitrate Calcium spark small.

Bone black pressed down with the finger in conjunction with the pencil point is better than the points alone. It seems probable that pencils of bone black pressed hard in a mould would be very delicate.

Benzoic acid no spark

Caustic Magnesia spark but no good

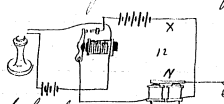
Lythargium no spark

Carbonate of lead no spark

Sesquioxide of iron no spark

Arsenate of Copper improvement on Carbon points makes longer spark

We now put on a self breaker thus:—



We found that if engine was connected in X circuit it either added resistance, or the spark of the break sets up a part for the self induction of the magnet N + prevents the generation of the Etherism.

Cast iron points between 2 carbon points give the best sparks yet.

Tar no sparks

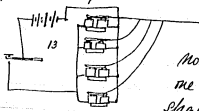
Ferrocyanide of iron no spark

Acetic Potash slight spark

We tried placing iron filings on a piece of paper over an electromagnet but the result was no better than if the magnet was not used.

Iron reduced by Hydrogen gives no spark hardly

Tried the Etherism from several magnets connected of for quantity thus:—



Spark not so good as when a single bar of cadmium is used. The magnets were not very even resistance. Took out one magnet which was fine when spark was not equal to single spool + cadmium. We tried middle power of our microscope + spark appeared about twice size. The glass lens or condenser at a certain focus makes the spark small but excedingly sharp + beautiful with various colors. We arranged 3 6 ohm magnets thus.

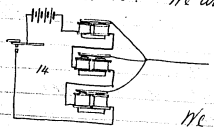


Fig 14 + the spark was better than with the 25 ohm magnet + Cadmium bar that we had been using all along.

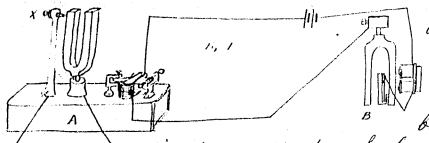
We now put in a single spool magnet of about 400 ohms + a cadmium bar on it + got a moderate spark, very irregular.

By connecting the top + bottom of core to line also improved it immensely. made it as good as 25 ohm spool + magnet.

Nov. 26th 1875. Chas Batchelor

43 Acoustic Telegraph.

We had two new tuning forks arranged thus. We tried A + B together but found we could not get A to respond although the vibrations came clearly on the magnet besides the rigid screw X upon the long upright dampened the fork badly.



We now had it altered thus: Fig 2 but still could not get them to work.

Disconnected magnet of B but kept contact broken in circuit with magnet A. By striking it we sometimes got a correspondence but not after. It then occurred that the fork of B made a double vibration, the prongs vibrating in the regular way, + the whole fork besides. the thin shank screwed into the wood support giving by the power of the magnet produced a false vibration + gave no results when held over a column of air of any length. To prevent this vibration the support should be metal, the whole apparatus mounted on metal + the poles of the electromagnet placed on both sides of the forks so as to balance this effect + give equal amplitude of vibration to both prongs. It is probable that the magnet grasps one prong + compels it to return before it has made the full swing, hence the other prong will not be in sympathy with it

It is also probable that as the movement of one prong is made defective the other should be made equally so to obtain proper results so we shall make magnets to have one pole on each prong of the fork

Nov 30th 1875 Chas Batchelor

(44) Etheric Force

We found the addition of battery to the Stable wire vibrator greatly increased the volume of sparks. Several persons could obtain sparks from the gas pipes at once each spark seeing equal in volume & brilliancy to the sparks drawn by a single person. If sparks are drawn off by a tonic held in one hand, the placing of the other hand on another part of the gas pipe will materially reduce the sparks

A very confusing & inexplainable experiment we had thus:- At the extreme end of a line of gas pipe at the other end of room brilliant sparks were drawn from the brass nut of the pointed burner, three feet from this burner was another which when grasped by another person standing on the dry floor reduced the volume of sparks drawn from the first burner to a point where they were imperceptible or nearly so, when the hand was taken off the sparks acquired its full brilliancy. Water was then poured to over the floor & a large piece of iron laid on it & connected to No 2 gas pipe by copper wire thus giving it a good route to it wds electricity. The sparks on No 1 Burner were undiminished in brilliancy. A person now grasped No 2 burner & stood on the wet part of the floor & instead of diminishing as before it did not affect it at all.

Several persons now grasped the pipes & Edison with a knife in one hand & a piece of wire in the other connected to the gas pipe obtained brilliant

sparks between knife & end of wire

A wire from the pipe was led to one of the iron pillars, to the stove & other metallic objects all of which showed brilliant sparks

Edison now grasped the pipe & with the other hand holding a piece of metal he touched several other metallic substances obtaining sparks showing that the force passed through his body.

Touching the Cadmium at intervals with a red hot iron gave no result

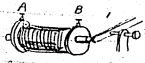
The spools were taken out of a Hidder magnet electric machine & the armature revolved at different speeds in front of the permanent magnet but without result.

Nov 30th 1875 Chas Batchelor

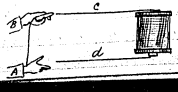
(45) Etheric Force.

Further experiments were tried to endeavour to prove that Etheric force was electricity of a certain degree of tension.

Smith from Chester's came over with a small induction coil & made the statement that it was induction. From x with 2 cells he could get no sparks (because that was not enough battery to get a spark between copper & copper). out of

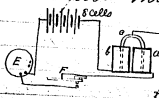


holding the hand near A or the outside of the coil the spark immediately appeared upon x. This was nothing more than induction as the sparks could be felt & seen jumping to the hand from the outside layers of the coil thence through body to other hand & so to x thence to top coil of primary to lower coil of secondary connected to B. This could be illustrated thus; the distance between d & c was too great to jump.



to jump but when the space was filled by a partial conductor the spark was obtained. The spark between A & B terminals of the secondary was ¼ on an inch. Mr Smith did not stop to witness the production of Etheric force under conditions which precluded induction. Mr Edison however gave him a diagram shewing how to obtain it from a sounder magnet with wire laid over the poles of magnet. At 8 PM we took our induction coil which gives ¼ spark & could produce same result as Smith (if) produce the spark from X by electrical induction, we then connected one end of secondary to the gas pipe leaving the other in air no spark could be obtained on pipes, we then connected the terminal in air with a piece of metal on the table & moistened it still no spark on pipes. Used 8 cells on primary. Mr Edison then left both terminals in air of secondary & connected X to Gas pipe & got good sparks. He then

connected A & B terminals of the secondary coil together still got spark but weakened as it should be part of the force going off in electricity though a small quantity of Great tension. I then disconnected the gas pipe wire from X & attached it to the secondary terminals which were fastened together could get no spark at all then from gas pipe. We now tried two 200 ohm spools thus:— a & b are the two spools con-



-nected with their two inside ends together, C is a thick copper rod bent in the form of a horseshoe & placed in the centre of each helix b & a but not touching either C is connected to our graphite points & to the gas pipe. E is a Bradley rheostat F a Key & everything thoroughly insulated. To prove the

insulation we connected the prime conductor of our plate glass machine to the Key F charging all the apparatus, upon disconnecting the prime conductor after ½ minute of time we got a spark from F notwithstanding the numerable points for the static electricity to dissipate from. We now received sparks on the graphite points with 1000 ohms resistance in the rheostat or from a strength of 1/100 of a bunsen cell on an internal resistance equal to itself. We now reversed the connection in the spools so as to make no magnetism (we used no iron) so to speak & we could the spark though the electric circuit had 2500 ohms resistance in it or 1/250 of a bunsen cell. We have noticed that when using an iron core & it is allowed to produce magnetism we get less etheric force & in proportion as we pull out the iron & insert the copper in its place we gain etheric force & if we connect the spools to give no magnetism we obtain the greatest etheric effect.

We took the copper horseshoe out & laid them

on the spools so that the ends just covered the holes in the spools & we could get the sparks when the electric circuit had 1000 ohms resistance. We now put in the vibrator used in our first experiments & increased the battery from 8 to 20 cells & connected X (see article 38 Fig 1) to gas pipe. Charley Edison hung to the gas pipe with feet above the floor & with a knife got a spark from the pipe he was hanging on. We now took the wire from vibrator in one hand & stood on a block of paraffine 18 inches square & 6 in thick, holding a knife in the other hand we drew sparks from the stove pipe. We now tried the crucial test of passing the etheric current through

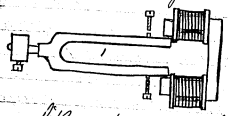
The sciatic nerve of a frog just killed. Previous to trying we tested its sensibility by putting the current from a single bunsen cell; we put in resistance up to 500 000 ohms & the twitching was still perceptible. We used the induced current from our induction coil having 1 cell on primary the spark jumping about 1/50 of an inch terminal of the secondary connected to the frog & it straightened out with violence. We arranged legs to pass etheric force through it; we placed legs on an inverted beaker & held the bare ends of the wires on the ends of glass rods 8 inches long; on connecting one to the sciatic nerve & the other to the fleshy part of the leg no movement could be discerned although brilliant sparks could be obtained when the frog was in circuit on the graphite points. Dr Beard was present when this was tried. The frog was now tested for delicacy with an electric circuit & although it had lost a little of its delicacy it was still exceedingly sensitive.

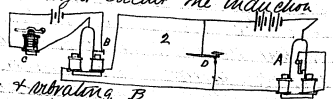
Dec 13th 1875

Chas Batchelor

(46) Acoustic Telegraphy

Coffin having transmitter & receiver made on this principle we found that we could not work them by direct contact so as Edison hit upon this plan which answered admirably & worked like a charm. With straight circuit the induction of sounder will not allow it to close



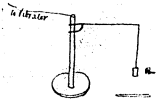


In this case vibrator A is always running & vibrating B when you press down key D it short circuits A & of course B stops & closes C sounder, which is quite the reverse of the sounder closing when you vibrate the fork. A very good idea.

Dec 3rd 1875

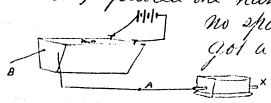
Chas Batchelor

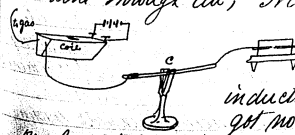
47 Etheric Force



Tried several different kinds of chemical crystals to ascertain if attracted or repelled by etherticity but with no result

Tried experiments with induction sparks to obtain scintillations & found that they were nothing like what they were from the etheric yet the spark jumped 1/4 of an inch. We tried an experiment with the large coil giving 1 inch spark connected thus one end of the secondary coil was connected to the graphite points & everything well insulated, placed one hand at B & touched X got no spark but on touching X we got a spark & strong shock on tongue; detached the hand from B but still kept tongue on X no spark; put the hand to X & got faint sparks; stood on insulated stool & got shocks, (put the wires on glass tubes 3 inches apart no spark touched the hand to the other wire & could draw sparks 1/4 of an inch long from it still no sparks could be drawn on the graphite points) connected a wire from A to gas pipe no spark, put the hand to X got a faint spark & shock on tongue, shewing it went through air, Tried this c to a glass rod





3 feet long 1/2 inch in diameter well warmed & wiped with silk; with induction current on full ~~we~~ got no spark, put the wires on glass tube 3 inches apart. no spark.

touched the hand to the wire on left & could draw sparks ⅛ of an inch long from it still no sparks. Stood on insulating stool with hand on wire to left felt strong shock, no sparks, made the hand approach within 8 inches of the wire on left got sparks tried it a number of times the approach of the hand rendering sparks visible. This proves quite conclusively that the Etheric force that cannot jump through space will travel through a length of glass many times greater than a high tension spark jumping ⅛ of an inch

We tried the following substances made into solution & paper wetted with them to see if we could get the force to mark on any.

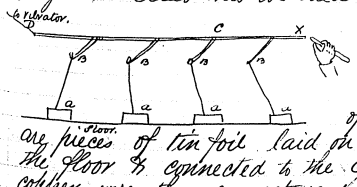
Caustic Magnesia & Silicate of Soda no mark
Oxalate of Cerium " "
Citrate of Potash
Carbonic Acid & Silicate of Soda
Ferrocyanide of Potassium
Sulphate of Manganese
Bichloride of Mercury & Sil of Soda
Phosphate of Soda
Lycopodium
Nitrate of Berberin, Acetate of Lime
Sulph carbolate of Soda, Sulphate of Morphia
Bichromate of Ammonia, Sulphurate of Copper
Tartrate of Ammonia, Iodine resublimed
Bicarbonate of Potash, By Iodide of Mercury
Chromate of Potash, Camphor.
Carbonate of Copper, Arsenate of Manganese
Carbonate of Ammonia, Sodium hyposulphite
Chloride of Nickel, Bisulphate of Potash
Thymol, Iodide of Sulphur, Antimonic Acid
Sulphur, Protochloride of Iron, Iodide of Antimony
Morphine, Acetate of Morphine, Sulphate of Ammonia
Iodide of Silver, Brucine, Citrate of Quinine,
Cyanide of Silver, Tetanic acid, Tannate Quinine
Asparagin, Sulphate of Caffine.

Hypophosphate Quinine, Lactophosphate of Bismuth
Lactate of Bismuth, Urea, Bromide of Silver,
Sulphate of Nickel, Muriate of Quinine,
Sulphuret of tin.

Dec 3rd 1875. Chas Batchelor

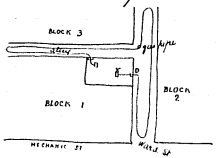
48 Etheric Force

Tried the following experiment upon a galvanoscopic frog: This frog gave contractions with one cell of Bunsen battery through one water rheostat about ten inches long; & when connected with the vibrator feebly contracted the frogs leg though not at all in proportion to the sparks got under the same conditions. Tried it several ways & got the contractions from the supposed Etheric current. Thinking that it might be due to the creeping of the induction current from the legs of the battery stands which were wet in some places we wiped them dry, but got it again with the same force. This would seem to be one proof that it is electricity, although not conclusive as the insulation of the battery was not excellent & the weather was damp having rained all night. Also this we tried:—

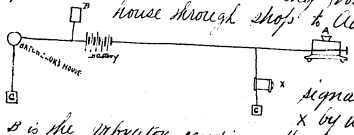


D goes to vibrator & battery, C the several gas jets in different parts of the room, a, a, a, are pieces of tin foil laid on a wet spot on the floor & connected to the gas jets by a copper wire thus connecting without resistance all the gas jets with the floor, at the furthest end from the vibrator the sparks could be drawn

off apparently of undiminished brilliancy.
Another experiment was tried:—



X is the vibrator on the operating table in laboratory thoroughly insulated as also the battery to the end of the vibrator was attached a small uninsulated copper wire 23 yards. This wire was taken out of the door D in the wet sheet (raining all night) & laid in the gutter to Mechanic St back to shop, up the alley & back in at the side door & up into the room above the laboratory & connected there with the carbon point, the other point being in contact with the gaspipe. We got the spark all right. This wire was also wound the lamp post in the street. The carbon point being disconnected from the gaspipe the spark was got at intervals.
This experiment was tried thus upon our private telegraph line, a short wire running from Batchelors house through shops to Adams house.



Batchelor could transmit signals to the relay X by working his key. B is the vibrator sending etheric currents to Adams house. A is the box with gaspipe points. Notwithstanding that Batchelor was transmitting signals to Adams in the ordinary manner the etheric currents were plain & not interrupted by the morse signal.
We connected vibrator with the speaking tube & got the sparks in the 4th floor off the staples that held the tube although we could not discern any from the tube itself we were standing on hard rubber.

Dec 4th 1875.

Chas Batchelor

49 Etheric Force.

We put up 16 cells Bunsen & using a Phelps as a vibrating sounder, insulated both battery & sounder on glass bottles 7 inches high, wiped perfectly with warm handkerchiefs. The spark was exceedingly strong from the vibrating lever. A file suspended from a silk floss fibre (Fig. 1) having a length of about 2 feet was allowed to touch the metallic part of sounder & brilliant sparks were obtained. Three persons grasping hands & standing upon sheets of paraffine 12 inches square & 1/2 inch thick drew sparks from the adjoining stove, when another person touched the sounder with any piece of metal. The three standing on floor gave same result, but it did not probable the spark was weakened to a point where it was difficult to see especially as the pipe was rusty.
The galvanoscopic frog giving contractions with one cell through his water rheostat was then placed in circuit when the wires from the vibrator & gas pipe were connected slight contractions were noticed sometimes very faint & marked shewing the apparent presence of electricity which from the high insulation seemed improbable. Dr Beard who was present inferred from the way the legs contracted that it moved on both opening & closing the circuit & test this we disconnected the wire between the frog & battery & placed instead of a vibrating sounder, a simple morse key & a sounder taking the etheric from armature. The spark was now tested in the box & found to be very strong it was then connected to the nerves of the frog but no movement of any kind upon working the key could be detected although the brilliancy & power of the spark was undiminished. The thought then occurred to Edison that the movement of the frog was due to mechanical

vibrations from the vibrator, (which gives probably 250 vibrations per second) passing through the wires irritate the sensitive nerves of the frog. Upon disconnecting the battery wires & holding a tuning fork giving 336 vibrations per second, to the base of the sounder the vibrations over the wire made the frog contract nearly every time & as the sounder is somewhat different from a perfect tuning fork inasmuch that it probably transmits some longitudinal vibrations which are infinitely more irritable than ordinary ones, even to a human being. The contractions of the frogs legs may with considerable satisfy be said to be caused by these mechanical vibrations being transmitted through the conducting wires.

Dec 5th 1875

Chas Batchelor

Longitudinal Vibrations

We took a long iron wire 1/16 of an inch in diameter & rubbed it length wise with a piece of leather with resin on it for about 3 feet backwards & forwards; about ten feet away we applied the wire to the back of the neck & it gives a horrible sensation showing the vibration conducted through the wire. Mr Edison thinks there is great probability that certain tuning forks will set certain nerves in the body vibrating in unison with them & with proper means & different forks, singly or combined, all the effects upon the muscles or nerves produced by induction currents can be produced by forks.

Dec 5 1875.

Chas Batchelor

Galvanoscopic Frog.

A frog prepared at 2 a.m. & allowed to become quite dry & stiff upon wetting was exceedingly sensitive at 5 30 AM being 3½ hours.

Dec 5 1875

Chas Batchelor

Acoustic Telegraphy

We found that the amplitude of the vibration of the large 6" forks was practically insufficient to work the sounder. The fusion of the points at so close an adjustment being one of the objections. We moved the spring contact on the self acting fork nearer hoping that the pressure dampened the fork & threw it out of unison, but found that placing the contact here where the swing was less was not a success although it appeared to give the fork a better tone. I made the receiving fork very weak owing to the lightness of the transmitted waves, attempting to lengthen them made the play of the spring in transmitter so close that it stuck & sent bad waves.

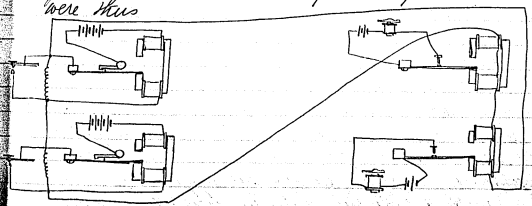
We concluded to make thinner forks & whilst they are making Batchelor arranges thin reeds as temporary devices till the forks are completed.

Dec 6th 1875.

Chas Batchelor

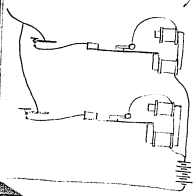
Acoustic Telegraphy.

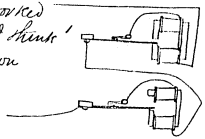
Tried the four reed vibrators & had them so adjusted that by sending one set of vibrations its corresponding reed gave an amplitude of ¼ of an inch while the other scarcely moved & by sending the other set of vibrations the other fork did the same, but when both came together it was mixed up badly. The connections were thus



We also found that every time we altered the self make & break spring on the transmitting reed it altered the receiving reed, throwing it out so much sometimes that we were compelled to lengthen or shorten it of an inch. At one time we received separate signals quite readable but there was no margin & the means of adjustment were entirely inadequate. Tried putting in a WU Relay & receiving vibrations on that. It is probable that Helmholtz's resonators would pick out the signals. We tried the following connections but they did not work well.

We also tried Fig 2 & it worked fair but not so good I think as the method first shown





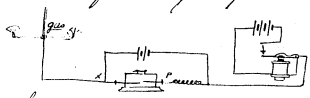
Dec-9th 1870 Chas Batchelor

(54.) Etheric Force

Tried several experiments to telegraph over the wire running from the Laboratory to A & P Yd Off 140 Broadway N.Y. This wire crosses into N Y at 63rd & is 26 miles long passes through 3 cables. In W.U. sounder vibrating with 12 cells of battery, the wire running to New York & New York connecting the wire direct to the pencil & from the other pencil to the earth no spark was received. The earth wire was then put on at Newark, nothing. New Brunswick end of wire was then put on, nothing. Several changes were made but no spark received. So we have ascertained that all telegraphic apparatus makes this spark & that one generator connected to one

end of the box & another to the other end, we obtain about double the intensity. The addition of a third however on one end decreases the spark & on the other end increases it. It is reasonable to suppose that the spark might be neutralized by other generators being connected to the main ground wire in New York office. After Johnson & Adams returned from N.Y. we connected a wire from one of the acoustic telegraph insts: & run it out of doors (weather cold & ground frozen) but did not succeed in obtaining the spark more than 25 feet away from the door. When however the acoustic vibrator was in we got it clear round the block about 1200 feet. The sparks only occurred at intervals, & we used bare No 23 wire.

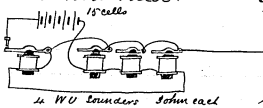
The following experiment was tried:-



The spark passed through box undiminished.

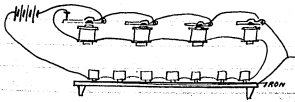
We also tried connecting the wire from battery at X instead of X but no change in spark.

We now tried:-



Sparks exceedingly brilliant shewing that the amount was increased greatly. We then tried this:- the box X was detached & a wire 3 inches long left fastened on to the pencil almost continuous sparks could be obtained when this was held within 3 feet from the sounders.

We now tried:-



The addition of three exha magnets placed on a bar of iron reduced the strength of the spark

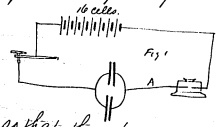
The total resultance is what in all probability brought it about. The iron bar was laid on bearable alas on hard rubber. The magnets were first laid on bare iron afterwards paper was placed between the core & iron. Dr Beard was present.

Dec 9th 1875

Chas Batchelor

55 Ether force

Dr Edward, president of a scientific association in Newark was present & stated that the phenomenon was far from a new force that there was not any more new forces. The sparks were simply due to inductive electricity of low tension. Notwithstanding that the spark could be obtained through glass a greater distance with ethric than with a jump spark from an induction coil or from a plate glass machine. He could give no idea how to prove it. The following experiments were undertaken to prove if possible Mr Edwards assertions. Two condensers of about 250 microfarads capacity each were connected thus:—

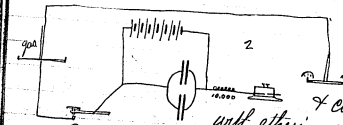


We obtained the spark as was to be expected

We now put in 10000 ohms at A & still obtained the spark.

We then opened the coil A so that the spark could go across the insulation

No spark on trembling the key. We then connected it thus

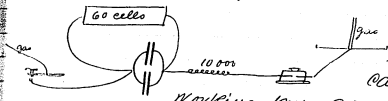


Got the spark through 10000 ohms but when it was opened no spark. The opening & closing of the circuit with ethric makes no difference.

Again a glass rod was used at A Fig 1 with wires ¼ of an inch apart no spark while ethric gives it through 3 feet with only 1 rounder vibrating.

Even induction coil current jumping ½ inch did not give it or plate glass machine

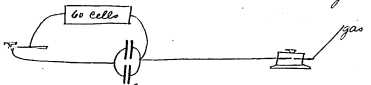
Another experiment was tried with low tension inductive electricity thus:—



The battery of 60 cells gave powerful electric light with carbons ½ inch apart.

Working key gave faint red sparks between pencil points as large amount of battery electricity passed through besides the static. The snap was much louder from the condensers than from a Leyden jar throwing ½ inch spark. This did not jump the air only gave spark on contact. When the resistance coil of 10000 ohms was opened got no spark by the most careful adjustment

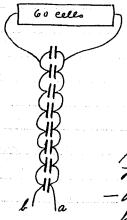
Connected it thus:— but got nothing.



Dec 11th 1875 Chas Batchelor

56 Condensers

We connected 8 condensers having an aggregate capacity of 22 Microfarads to our 60 cell battery in the following manner.—



By putting a & b together the most brilliant spark that I ever saw was given off. The scintillation went out from the contact points at least 3 or 4 inches. Thousands radiating from the centre like the rays of the sun each scintillation ended in a fork like a hen's foot, the snap was like the crack of a cap yet with all this power on

sparks were seen on the graphite points.
Dec 11. 1875

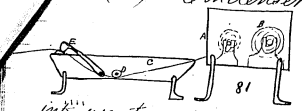
Chas Batchelor

57 Electric Light

Thirty one cells of 1½ Carbon battery was put up connected to an apparatus with Carbon points it was very brilliant & sufficient for lecture purposes. We found that when Sodium, Potassium or Iodide of Cadmium was used the light could be drawn out much longer & was more brilliant
Dec 11. 1875

Chas Batchelor.

(58) Condensers



Our apparatus made for making condensers some nine months ago have just been brought into use to make our condensers & we find the principle to be first rate. It is this. We first cut the paper into the requisite width & roll it on to small rollers to go into the oven. The small rolls are then placed in the oven & baked at 150° Fah. to get the water out of it. A large dish containing paraffin kept at 220° just hot enough for the water to pass off as steam & not boil the paraffin is kept in front of the oven. The paper is unrolled from the oven & passed under the roller D in paraffin & then under the stripper E which takes off all the superfluous paraffin & then drawn off in lengths of 20 feet & held a few seconds to dry perfectly it is then let down on a board which is marked to the length of sheet & cut.
Dec 25.

Chas Batchelor.

59 Etheric Force.

An Experiment tried tonight gives a curious result A is a vibrator B C D E are

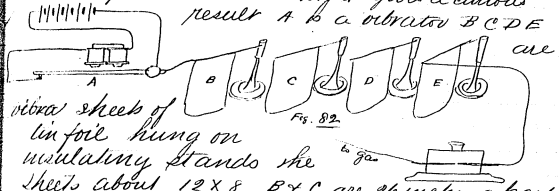


Fig. 82.

vibra sheets of tin foile hung on insulating stands the sheets about 12 X 8 B & C are 26 inches apart C & D 45 inches, & D & E 26 inches, B is connected to the vibrator & E is connected to point in box. the other point to ground. We received sparks at intervals although insulated by such space.
Dec 26

Chas Batchelor

60 Acoustic Telegraphy.

Worked 3 messages in the same direction on this principle each key

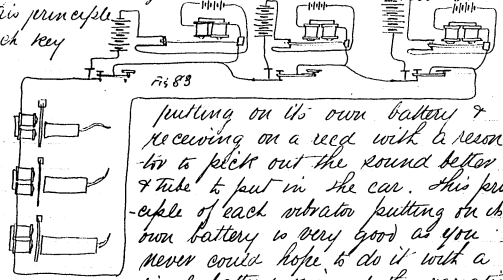


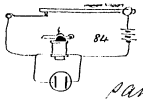
Fig. 83

putting on its own battery & receiving on a reed with a resonator to pick out the sound better & tube to put in the ear. This principle of each vibrator putting on its own battery is very good as you never could hope to do it with a single battery owing to the variation of the reeds when there are different numbers of magnets on.
Dec 26 1875

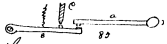
Chas Batchelor

(61) Acoustic Telegraphy

We found a means of receiving on a sounder off a reed by the following means. Fig 84 shows it. It is by putting a secondary battery or solid water shunt round the sounder. This secondary battery sends a current in the same direction on opening the electrical circuit. The vibrator strikes its contact point so rapidly that without shunt the induction from magnet would not allow the lever to come down but when the shunt is on its current operating in the same direction tends to hold it down. It seems strange that when you put 6 cells on to a local like this it will not respond but when you shunt ½ or ¼ of the current it works perfectly.



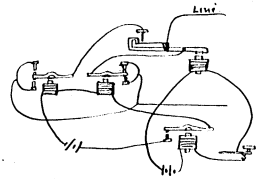
We have also found that it is necessary to have a contact on ~~transmitters~~ receivers like 85



a is a vibrator, b is the contact which is solid & rests against the contact screw c when the right note comes the lever drives the contact lever away from screw.

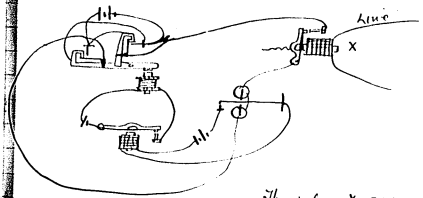
January 7th 1876.

Chas Batchelor

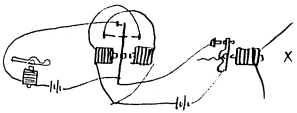


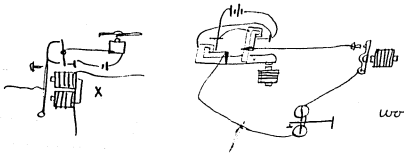
Doubler

In making both the back and front strokes on the down causes the operator to very easily get the "backstroke" & obviate this by transmitting a long opening of the circuit for closing and a short for opening. This causes the sounder at the receiving end to give a different sound on closing than on opening. The following are various devices for commuting two slight openings of a relay into regular dots and dashes on a sounder

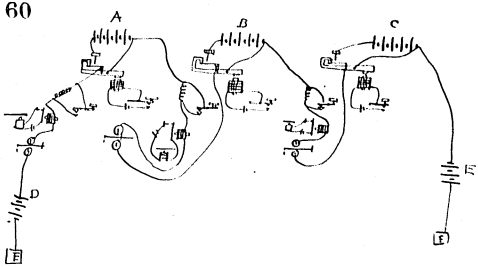


The relay X may work a back pouch on sounder and the sounder work the polarized relay.





works very well



Doubler by reversals, and increase and decrease batteries A.B.C are at way stations and have twice the strength as both D & E combined so that when D & E are on the line alone the current is say 100 in one direction but if either A B or C be inserted the current of D E is neutralized and 100 flows in the opposite direction.

Duplicating Press.

In printing copies when you want to take a number, if you put a very thin coat of shellac and alcohol on the stencil that it will not require much rubbing and an excess of ink does not blur the copy. The roller feels as if it was rollering a sheet of glass and makes a good copy.

If you oil the stencil shed a little bear working you can also take the first copy very quick.

The best paper for stencils for our No 1-2 presses we have found to be Grannis parchment paper No 10 very thin but almighty tough

For making large stencils for maps & plans a parchment paper must be used which should be wet & press frame & dry when dry it will be as tight as a drum. The stencil should not be made until it is dry and in using it will not make double lines by the paper running

Oct 1st 1896

Chas T Batchelor

Electric Light May 26. 1877

Notes

Liebig & Kopp Rept vol 1

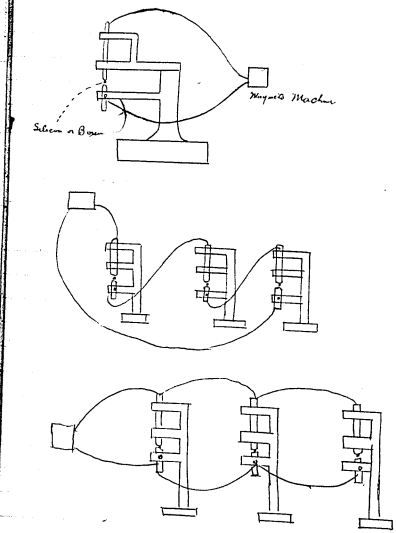
P 114 describes train gearing for velocing in oil large sectional area tube underlower note 117. P

Bellani deduces observation of Galton that lightly stretched brass wires in free air sound only during change of weather no sound obtained in either fine rainy or very windy weather.

This appears to belong to some other experiment not Electric light. for Electric Light see next Page

W. C

Electric Light Sept 9. 1877.



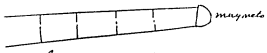
The employment of Silicon or Boron = (metalic arms to move the continuity by their conductivity and Satile have resistance enough to allow the arc to form. besides the pressure of silicon keeps the carbon points at a proper distance by its pressure between them

Copied from Original drawing page 1. this 28th day of September 1878

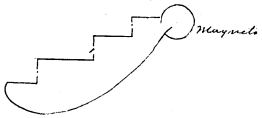
Wm Carman

Electric Light Nov 1. 1877

I have tried Boron Ruthenium Rhodium and the almost infusible metals for operations in my electric light device = Boron is very High resistance and would do if arranged thus



Silicon on the other hand is very low resistance and would have to be arranged thus



I think powdered Silicon mixed with lime or other very infusible non conductor or semi conductors would be good as

Copied from original drawings page 2. this 28th day of September 1878

Wm Carman

Electric Light Dec 8. 1877

Further experiments with Ruthenium and Selenium prove their adaptability to substances of the light —
It was possible to get good results by powdering this selenium and putting it in a glass tube passing the current through the powder

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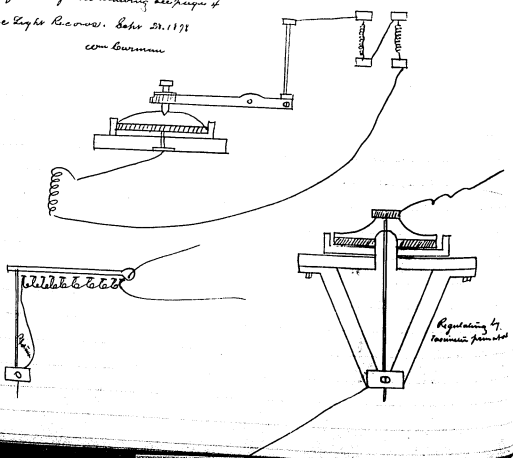
Copied from sheet No 3 Electric light original drawing this 28th day of Sept 1878

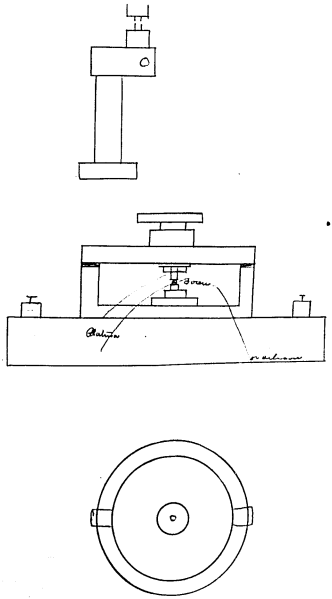
Wm. Carman

Electric Light April 14. 1878

Copied from original drawing see page 4
Electric Light Records. Sept 29. 1878
Wm Carman

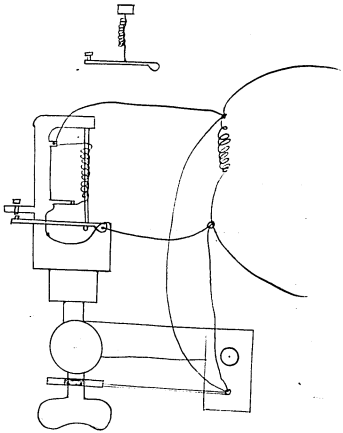


Electric Light Aug 27. 1878



Copied from page 5 of Electric Light records Sheet 28 Day of Sept. 1878
Wm Carman

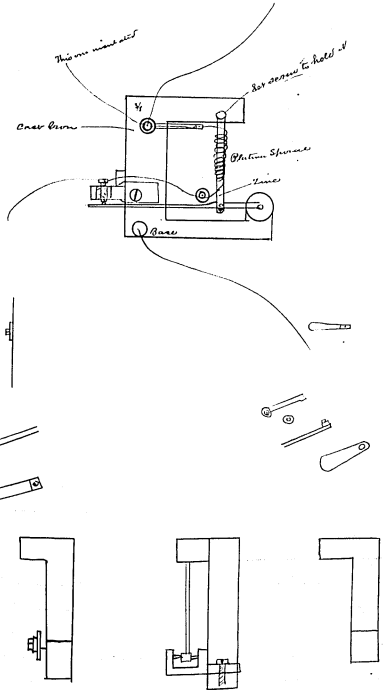
Electric Light Sept 10. 1878



Copied from page 6 of Electric Light record this 28 day of Sept 1878

Wm Barman

Electric Light Sept 10. 1878

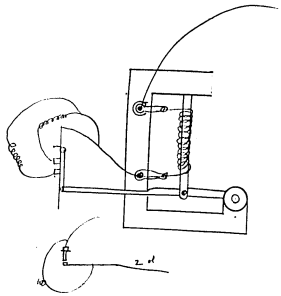


Copied from page 7 of Electric Light record this 28 day of Sept 1878

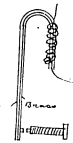
Wm Barman

Electric Light Sept 11. 1878

Subdivision

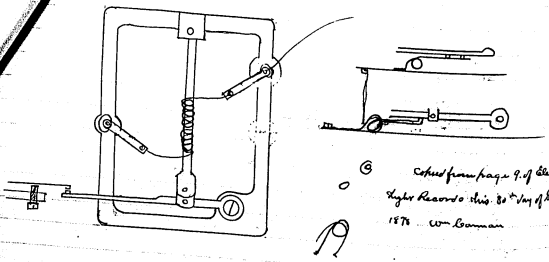


To prevent flickering fast in resistance so by bellcrank on end of lever



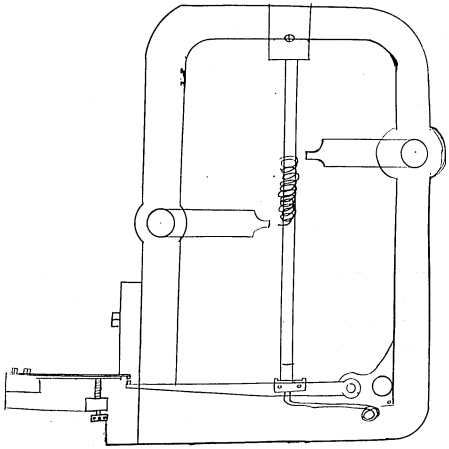
Thin strip of Brass and Iron together and bent up in a U shape. These are very sensitive

Copied from Electric Light record of Sept 11. 1878 Page 8 this 30th day of Sept 1878. Wm Barman



Copied from page 9 of Electric Light Record this 30th day of Sept 1878 Wm Barman

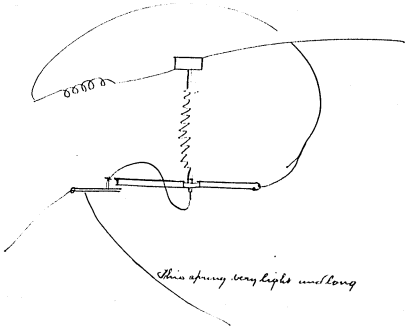
Electric Light Subdivision Sept 12. 1878



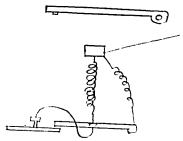
Copied from page 10. Elec Light Record this 30th day September 1878

Wm Barman

Electric Light. Subdivision Sept 12. 1878

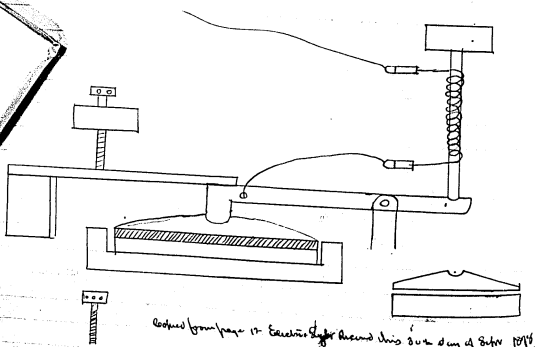


This spring very light and long



Copied from page 11 E. Light record this 30th day of September 1878

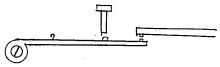
Wm Carman



Copied from page 12 Electric Light Record this 30th day of Sept 1878.

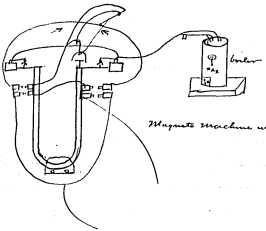
Wm Carman

Electric Light Subdivision Sept 14. 1878

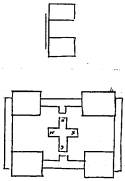


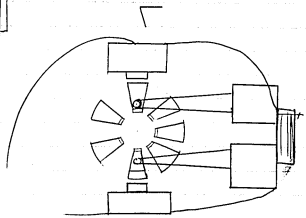
Copied from page 13 Elec Light Records this 30th day of Sept 1878 Wm Carman

Magneto Machines Sept 14. 1878



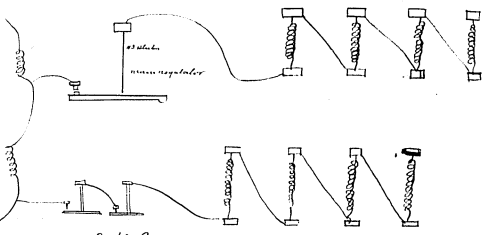
Magneto machine with fork

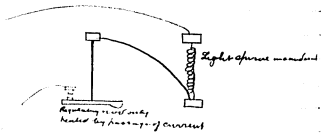


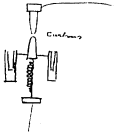


Copied from page 14 E. Light records this 30 day of Sept 1878. W Carman

Electric Light Sept 11. 1878

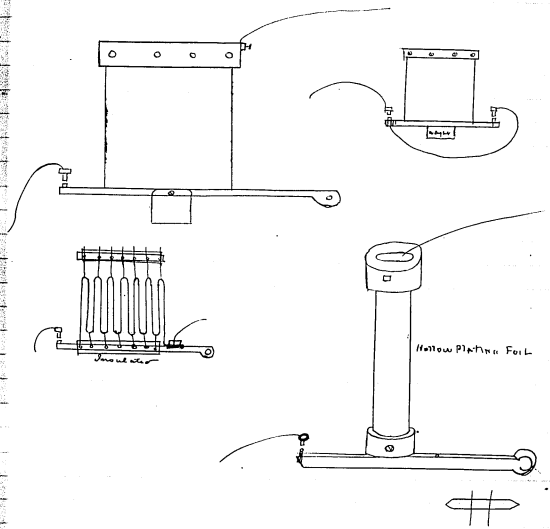






Copied from page 15 Elec Light Record
this 8th day of Sept 1878. Wm Bannan

Electric Light Sept 11. 1878

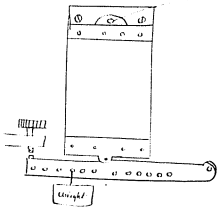


Copied from page 16. Elec Light record this
30th day of Sept 1878. Wm Bannan

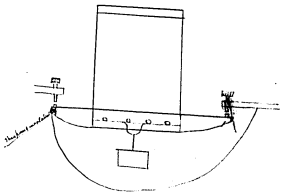
Electric Light Subdivision Sept 15. 1878

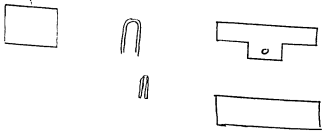
Knowse

Make "light" instrument like this



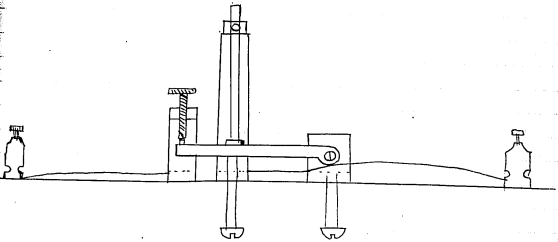
and another with double points

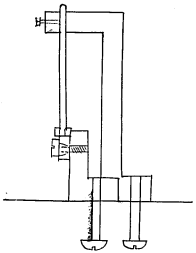




Copied from page 117 Elect Light Records Sept 20. 1878 . Wm Carman

Electric Light. Sept 16. 1878

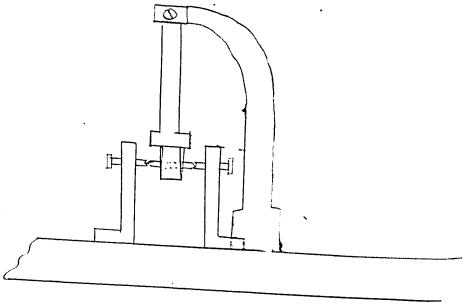


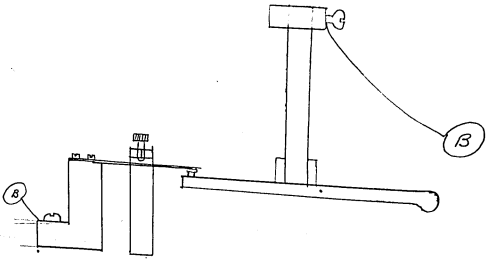


Copied from page 18 Elec Light Records this 30th Day of Sept 1878

Wm Carman

Electric Light Sept 17. 1878

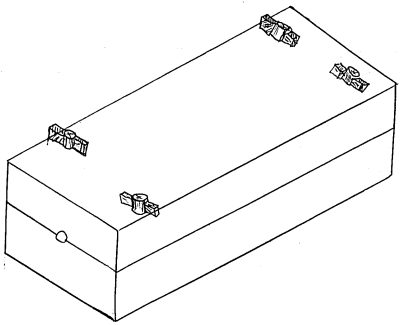


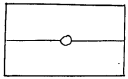


Copied from page 19. Elec Light records this first day of October 1878. Wm Barnum

Electric Light. Subdivision Sept 17. 1878

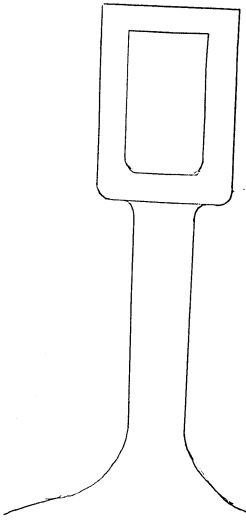
mould for composition for increasing the heat in spiral in a glass tube





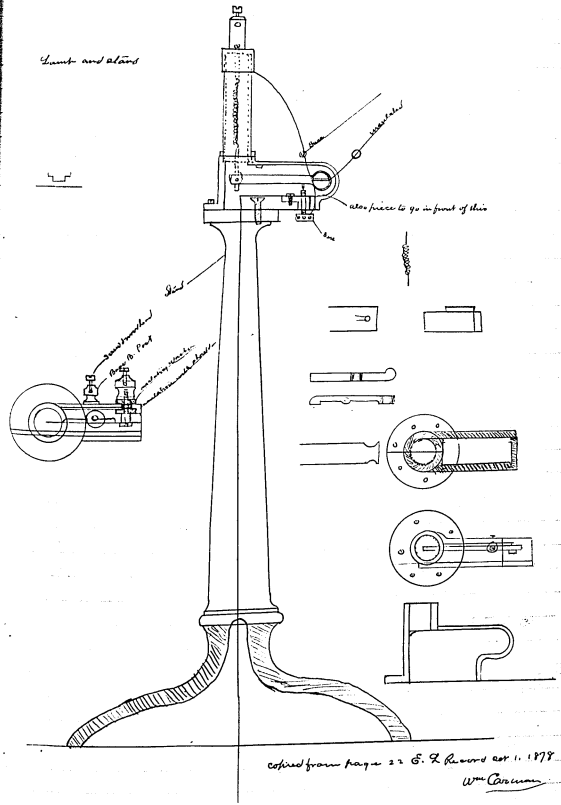
Copied from page 20 Electric Light Record this first day of Oct 1878. Wm Barnum

Electric Light Sept 17, 1878



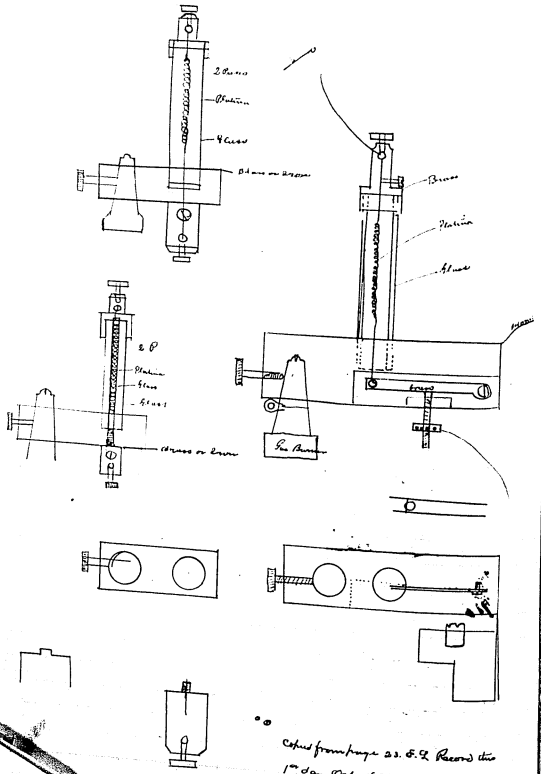
Copied from page 21 Electric Light Record
this first day of Oct 1878 . Wm Carman

Electric Light Subdivision Sept 17, 1878



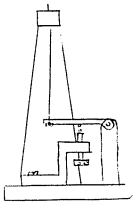
copied from page 22 E. L. Record Oct 1. 1878
Wm Carman

Electric Light Sept 17. 1878



Copied from page 23. E.L. Records this 1st day Oct 1878 W. Carman

Electric Light Sept 17 1878.



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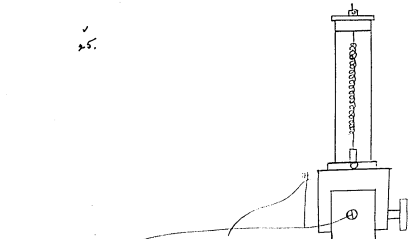
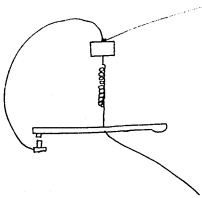


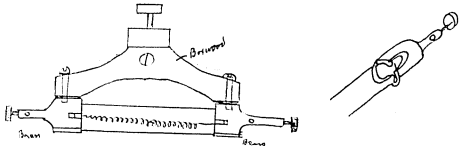
Copied from page 24 Elec Light Records this 1st day of Oct 1878
W Carman

Electric Light Sept 17. 1878



Copied from page 25. E.L. Records this 1st day Oct. 1878. Wm Carman

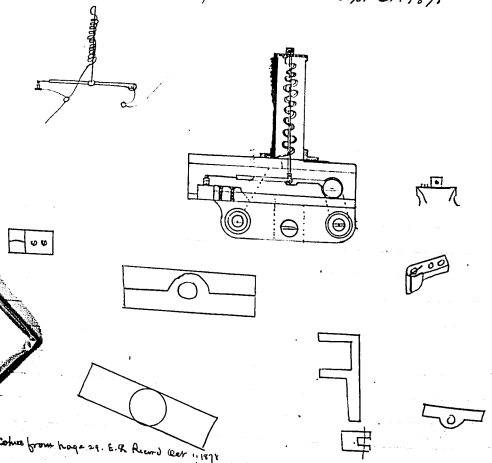
Electric Light Sept 18. 1878



Kruger makes one this way, with ear holes in the end

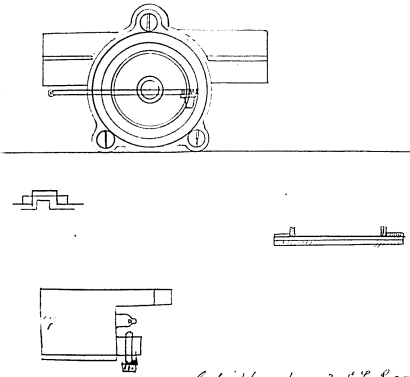
Copied from page 34 Elec Light Record this 1st Oct 1878 Wm Cannon

Electric Light Subdivision Sept 21. 1878



Copied from page 29. E.L. Record Oct 1. 1878
W Cannon

Electric Light Sept 23. 1878

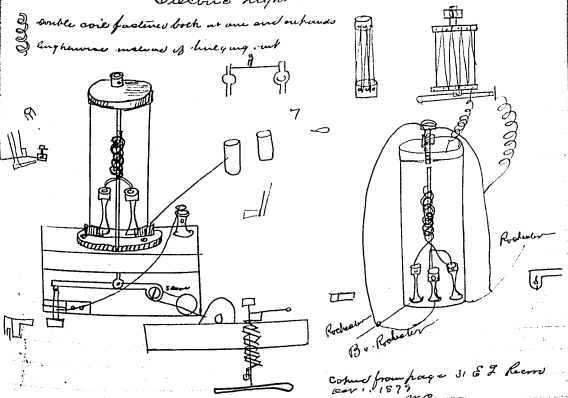


Copied from page 30 E.L. Record Oct 1. 1878
W Cannon

Electric Light Subdivision Sept 28. 1878

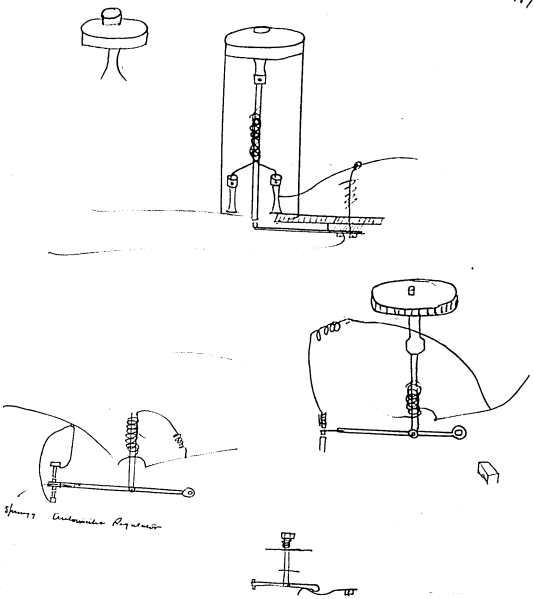
Double coil fastener both at one end and upwards

Engineers material of tinkering cut



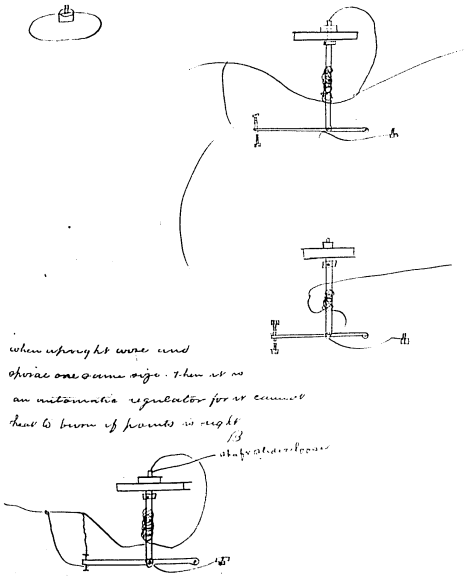
Copied from page 31 E.L. Record
Oct 1. 1878
W Cannon

Electric Light Division Sept 24, 1878

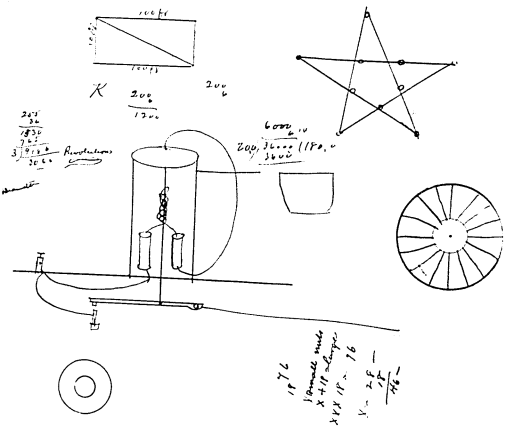


Copied from page 32 E & L record Oct 1, 1878
Wm Carman

Edisons Electric Light Subdivision
Sept 24, 1878



Copied from page 33 Elec L Record Oct 1, 1878
W Carman

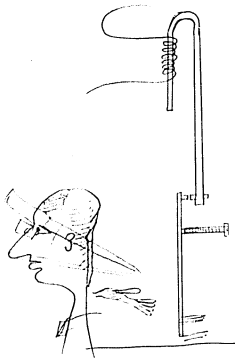


Two boys had 36 apples together & one had 18 more than the other how many had each

~~3 women went~~ 2 - 9 7 9 / 58 29 / 18 / 47

Copied from page 34 E. L. Oct 1. 1878
Wm Carman

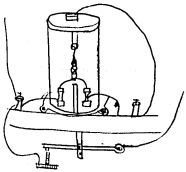
Electric Light Sept 25. 1878



Copied from page 35 E. L. Record
Oct 1. 1878 Wm Carman

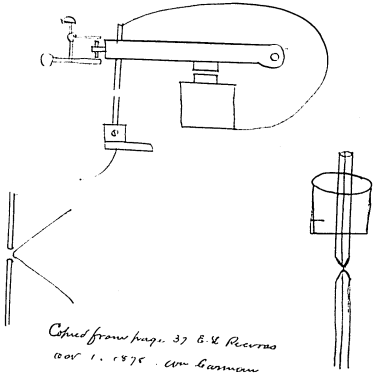
Electric Light Division Sept 25. 1878

we now have a perfectly regulating light spiral wound double to allow for expansion. and the wire in middle same wire as the spiral only the spiral is flattened to make stronger and allow more heating surface as the Platina rod expands or closes the cut off points at x and when the spiral and Platina ~~rod~~ are the right size. this is a perfectly automatic cut off; so that however much current you put on it will regulate before burning up although the contraction when cold has allowed the points to separate 1/8 inch



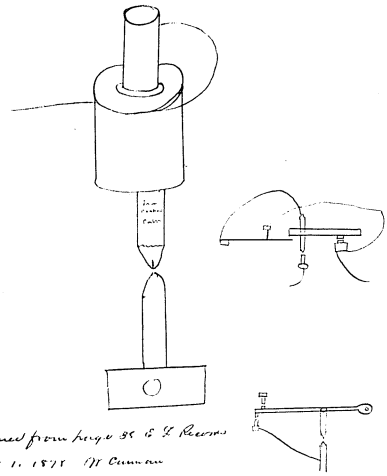
Copied from page 36 E. L. Records Oct 1. 78
Wm Carman

Electric Light Sept 25. 1878



Copied from page 37 E. & Record
Oct 1. 1878. Wm Cannon

Electric Light Sept 25. 1878



Copied from page 38 E. & Record
Oct 1. 1878 Wm Cannon

Electric Light Subdivision Sept 26, 1878

Last night we placed wound our light another glass tube & cemented it at bottom and filled the intervening space with alum and water. to prevent in a measure the radiation of heat from it. This has the desired effect to a great extent but we want something that will do it better

Copied from E. & record page 37
Oct 1. 1878. Wm Cannon

Electric Light Division Sept. 26. 1878

Experimented with incandescence of sticks of Carbon - it will expand and cut off similar to Platina or other metals but when brought up to give the same light as platina it melts very easy

---

I put sticks of different thickness and lengths of Carbon in place of platina in our light stand result was not comparable with Platina

---

we want Osmium or platinum - Iridium also buy Ruthenium

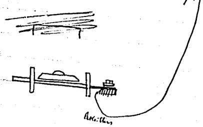
Sticks of finely divided platinum —

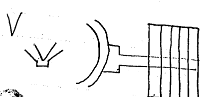
Copied from page 40 E L Records Oct 2. 1878
Wm Carman

Sept 27. 1878

Kruesi

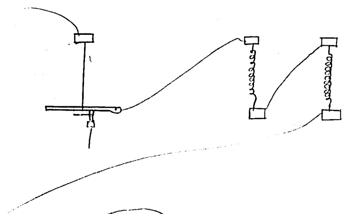
Will you fix this platina to the glass. and cut away the brass right under the tag X and make the tag on it narrower so as to make the platina have no pull on it whatever

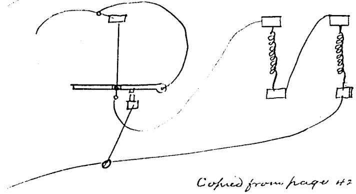




Copied from page 41 E L Record Oct 2. 1878 Wm Carman

Electric Light Sept 27. 1878





Copied from page 42 E L Record Oct 2. 1878
Wm Carman

Electric Light Sept 20. 1878

40 ft per foot - 211 200 ft per mile
46 .. per foot 243.480

1760 / 3 / 5280 — 5280 / 40 / 211200

2029 yds / 3 / 6087 / 40 / 243480

243480) 11.920000 (00489
9 73920
2185200
1950840
2344600
2191320

0004489

119245
00489
1073205
953960
1167 80
582908 05

000489
243480
00034320
1956
001467
0001956
000978
0011905 1920

0087
12000

000489 ohms
243480
20

00489 ohms
00978

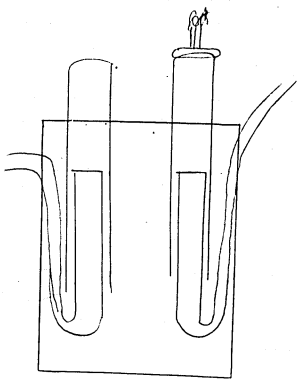
12000 ft copper 40 ft per foot

8 5/8 — 1009780 ohms

1'00000

Copied from page 43 Elec Li Record Oct 2. 78
Wm Carman

Electric Light Sept 27: 1878



Copied from page 44 E. L. Record Oct 2. 1878.

Wm Carman

Electlight Sept 27. 1878

8
9
8760
22
12
4

64
2
42
1
1024

50.2656
12
602 1872

Solid contents in inches

321.18
5.06
1221.6
1605.90
1618.14

32 118
608
96 354
192 708
193 671 0

5 280) 113 400 (21 1/4
10560
7 800
5 280
25 20

32
12
48

128

2 13/16

113 400

21 1/4
9
189

6 13
84

Copied from page 45. E. L. Record
Oct 1. 1878 Wm Carman

Electric Light Subdivision Sept 27. 1878

Length of time it takes to heat after Bunsen Burner to red heat the following substances

	Seconds	Remarks
Limes for O.H. Light	2	
Kaolin	1 1/2	
Tripoli	1	
Sulph. Baryta	3	
Whiting	5	
Fire clay	3	
Silicic Acid	7	
Woodbridge Clay	4	takes 7 to heat first time
Coral marble	5	
Pumice stone	5 1/2	
Platinum Black		first crate heats before Platinum
Caustic Magnesia		heats white when platina red
Carb Magnesia		" " " "
Caustic Magnesia		contracts less by heat than Carb Mag
Oxalate Cerium		Excellent good gets red before platina spoon

Copied from page 46 E. L. Record Oct 2. 1878

W Carman

Electric Light Subdivision Sept 27. 1878

made cylinder of burnt magnesia pressed for light and it retains its heat but the loose unpressed does it much better

Struck the idea that probably coating the Platina spiral with a saturated solution would be what we want

Solution Alum	very good bright and leaves good deposit on spirals
Tungstate Soda	no good
Chlo Potash	no good
Chloride Sodium	very good, small deposit
Acetate Lead	no good melts Platina
Sulphate Thallium	no good
Carb Lithia	fair something like oxalate lithium

Copied from page 47 E L Record
Oct 2. 1878 Wm Carman

Electric Light Sept 27. 1878

Oxide Zircon	not very good might try it further
Niobic Acid	fair reduch
Wolfram	not good
Cocaum Alum	not quite so good as magnesia
Osmium	N. G
Strontium	N G
Protochloride tin	N G
Lactate Zinc	fair
Carbic Strontia	N G
Brom of Cadmium	N G
Carb Lithia	N G
Oxide Glucinum	acts like magnesia
Ox Beryllium	not good
Acetate Aluminas	N G

Copied from page C L Record Page 48
Oct 2. 1878 Wm Carman

Electric Light experiments Sept 28. 1878
Continued

Antimonic Acid keeps its heat twice as long as platina spiral and both same color (red) —

Benzoic Acid burns up makes good lamp black
Silicic Acid " " G.

Asbestos. Incandescent — Good wind platina wire with it =

Bronze Powder takes long time get heat and stays red hot a very long time

Nitrate Silver very dull red but keeps it long time.
Carbonic Phosphorus takes a very long time to heat up and takes several seconds to cease luminosity after taken from flame.

Same with Brothine Phos —

Wachs. Phos — same and quicker —

Boneisum — not so good

Copied from page 49. E L Record
Oct 2. 1878 M Carman

Electric Light Sept 30. 1878

Effect when held in a flame by platina of

Chromium — when held in light gets red but not quite so much as platina it however keeps its redness three times as long as the platina. when held in powder and not spiral heated by H cells carbon no good

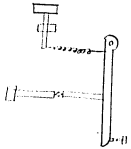
Oxalate of Cerium Burnt — I find that when I put small pieces of this on the Edge of the Burner on Burner they clear them and give off a very brilliant light and I see no diminishing of intensity in two hours I had been watching it
I find however it gets some of its brilliancy by being supplied with Oxigen as if I shut off the air in the bottom hole in burner the flame is brighter but the Cerium goes out almost entirely

Chromium — with 40 cells battery a small piece Chromium gives a light similar to Silicon (soft)

Chromic Acid — In flame — burns with very bright light and readily swells out and keeps hot but not longer than platina however —
In fact it gets hot and loses its heat both quicker than P
Copied from page 50 E L Record Oct 2. 1878
M Carman

Electric Light Sept 30. 1878

Chromic Acid burnt in flame
Residue is not a conductor of Electricity



Copied from page 51 E. L. Record Oct 2. 1878
W Carman

Electric Light Sept 30. 1878

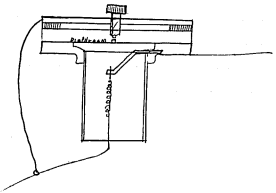
Cerium =

Chromium =

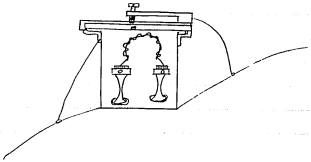
Boron from Borax in arc of carbon light good conductor
Metallic fracture brittle = form of bent cake –

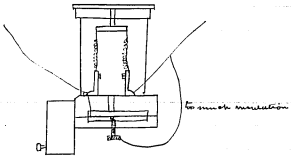
copied from page 52 E. L. record Oct 2. 1878
W Carman

Electric Light Subdivision Sept 30. 1878



Shows plan of cutting off by expansion of air working a diaphragm to close points

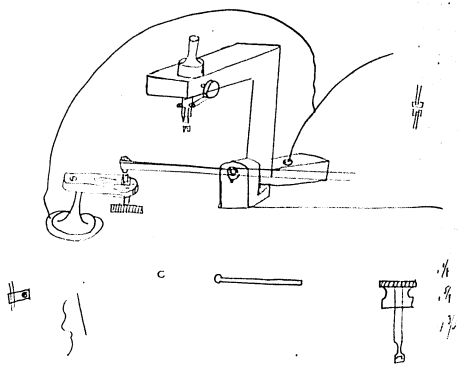




copied from page 53 E. L. record Oct 2. 78
W Carman

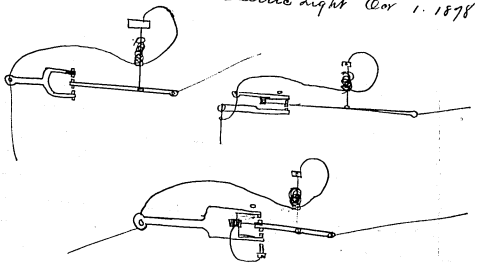
Electric Light Sept 30. 1878

make instrument for testing different



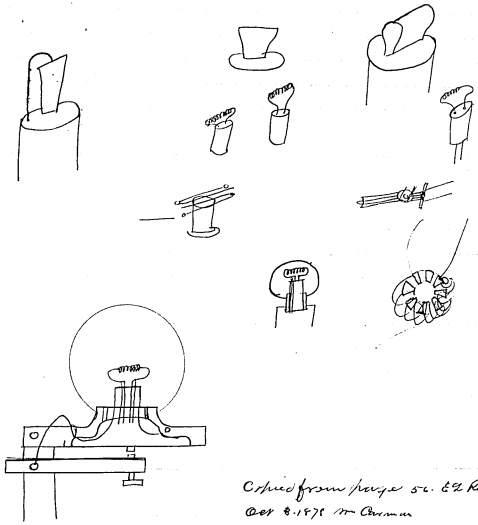
Copied from page 54 Electric Light
Oct 2 1878 Wm. Carman

Electric Light Oct 1. 1878



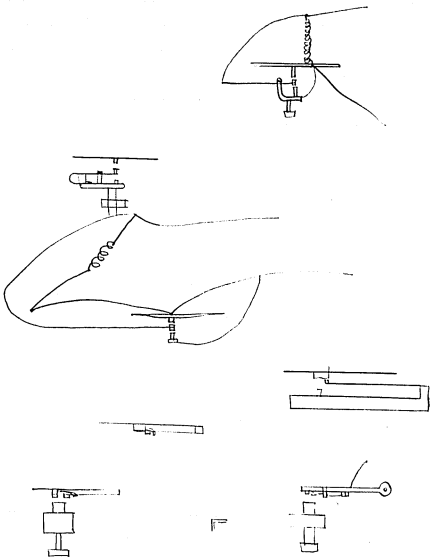
Copied from E. L. Record page 55. Oct 2. 1878
Wm Carman

Electric Light Oct 1. 1878



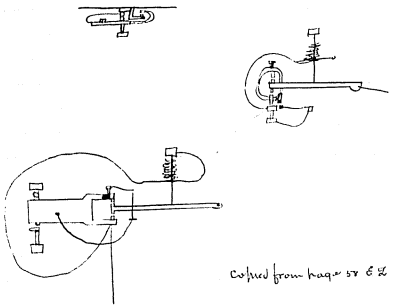
Copied from page 56. E. L. Records
Oct 8. 1878 Wm Carman

Electric Light Oct 1. 1878



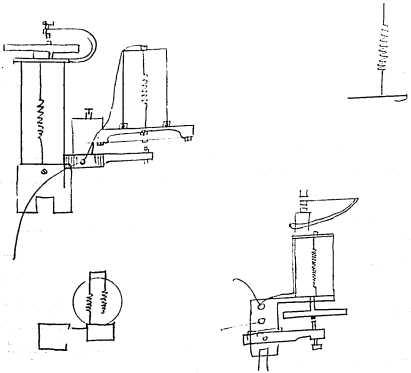
Copied from page 57 E L Record Oct 3. 1878
J Carman

Electric Light Oct 1. 1878



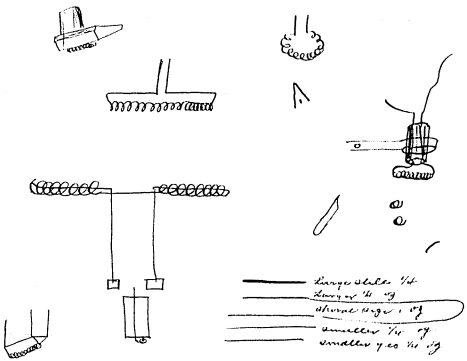
Copied from page 58 E L Records Oct 3. 1878
Wm Carman

Electric Light Oct 1. 1878



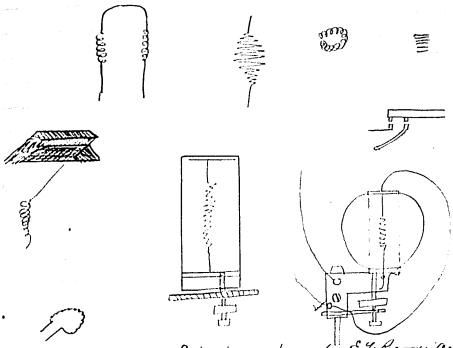
Copied this from page 58. E L Records Oct 3 1878 Wm Carman

Electric Light Oct 1. 1878



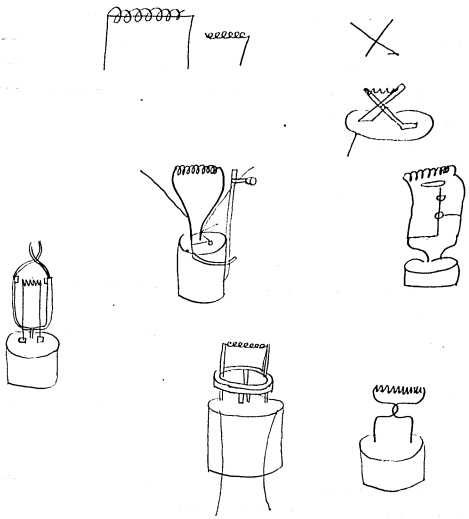
Copied from page 60 E. G. Record
Oct 8. 1878
Wm. Cumm

Electric Light Oct 1. 1878



Copied from page 61 E. G. Records Oct 3. 1878
W Cumm

Electric Light Oct 1. 1878

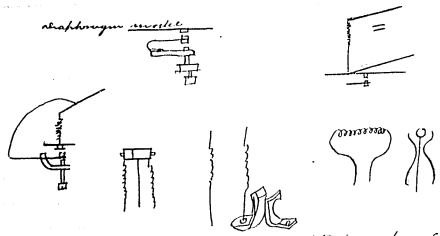


Copied from page 62 E.L. Record Oct 1 1878
W Carman

Electric Light Oct 1. 1878

New model –
Spiral so mounted
flexible frame

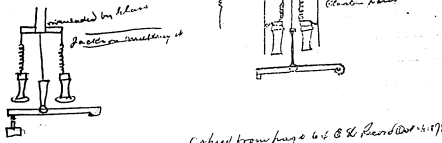
diaphragm model



Copied from p 62 E.L. Record
Oct 4. 1878 W Carman

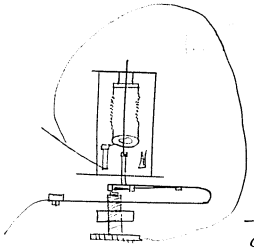
Electric Light Experiments

Double spirals are bad as even with Platinum they Sag down
with Great Heat and cut out some coils
Try this. use same size wire for
spirals and only as much in the two
as was in the one double spirale



Copied from page 64 E.L. Record Oct 5 1878
W Carman

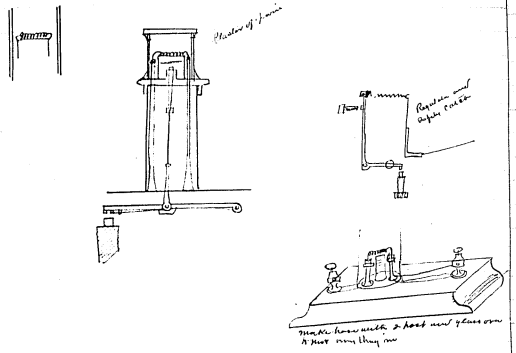
Electric Light Oct 2. 1878



Kreuzer
next one must have of
material of lever little thin and
2 platinum spirals of No 18
wire about 12 or 14 turns
on each

Copied from E. G. Reers Phy 65
Oct 11. 1878
McCann

Electric Light Oct 2 1878



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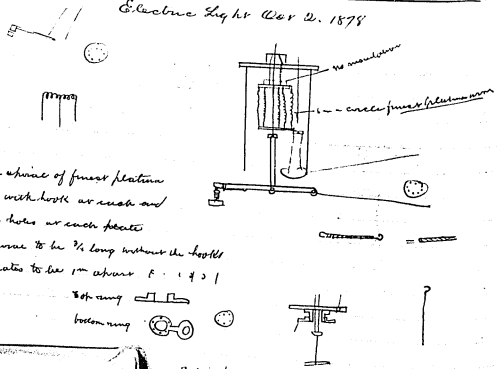
McCann

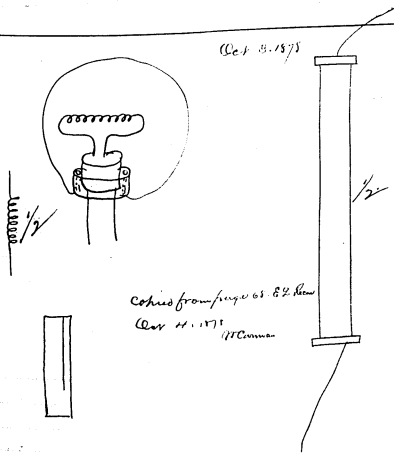
Electric Light Oct 2. 1878



make spirals of finest platinum
wire with hooks or such and
cross 6 times or such plates
the spirals to be 3/4 long without the hooks
the plates to be 1 in square 8 · 1 7 2 1

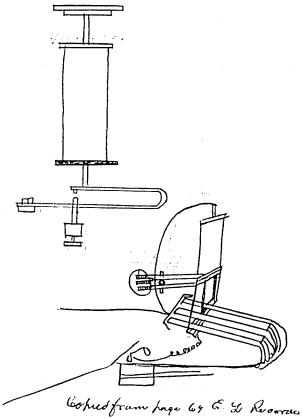
Copied from page 66. E. G. Reers Oct 11 1878
McCann

Oct 3. 1878



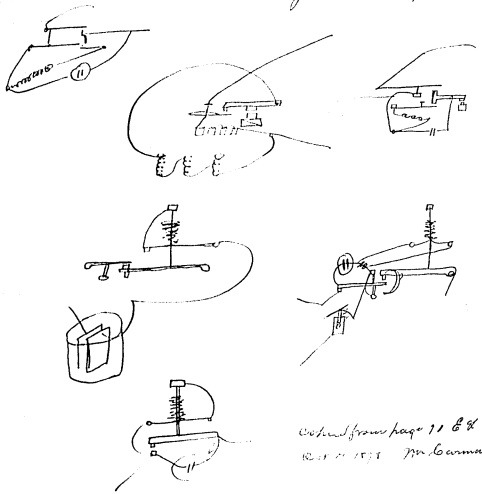
Copied from page 65 E. G. Reers
Oct 11. 1878
McCann

Electric Light Oct 3. 1878



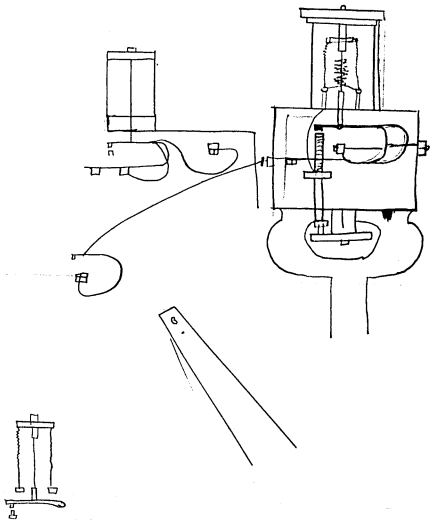
Copied from page 64 E. L. Record Oct 11. 1878
McCarman

Electric Light Oct 3. 1878



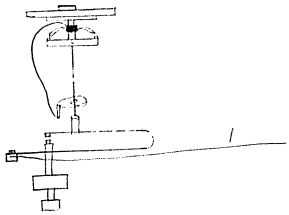
Copied from page 71 E. L. Record
Oct 11 1878 McCarman

Electric Light Oct 8. 1878



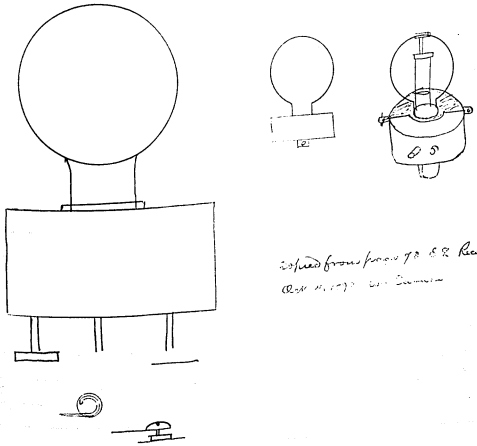
Copied from page 71 E. & Record Oct 4. 1871
W. Carman

Electric Light Oct 8. 1878



Copied from page 72. E & Record
Oct 4. 1871 W. Carman

Electric Light Oct 8. 1878



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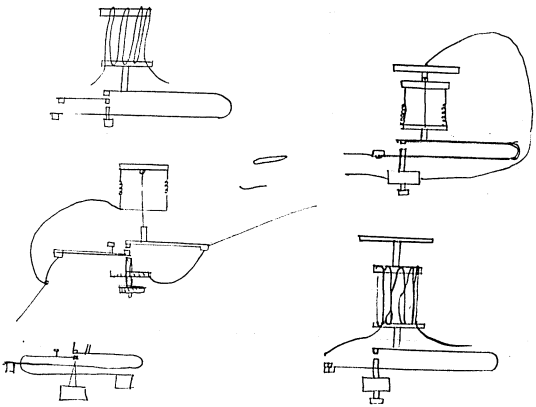
Oct 4. 1871 W. Carman

Electric Light Oct 3. 1878



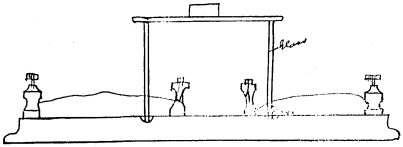
Copied from pages 74 E.L. Record Oct 11. 1878

Wm Cairns

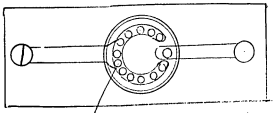
Electric Light Oct 3 1878

Krenge

make on a sounder



make connection for the inside part so that I can test them anywhere for circular or straight spirals



The holes I in the copper strip and through the base so that I can adjust the spirals close to the other one or keep further away

Copied from pages 75 E.L. Record Oct 4th 1878

Wm Cairns

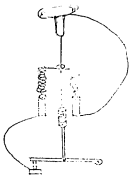
Electric Light Oct 3 1878

Jackson: —

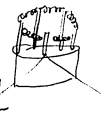
The bolt hold back for the spring at 4 was far away from the points you must put it right close up to them only 1/16 away from them

Copied from page 76 E L Record Oct 4, 1878
McCauman

Electric Light Oct 2. 1878

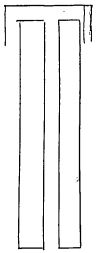


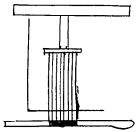
Armature [illegible] Nos

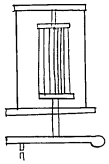


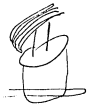
Copied from page 77 E L Record Oct 4, 1878
McCauman

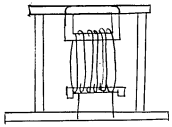
Electric Light Oct 2. 1878









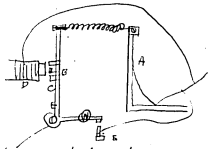


Copied from page 78 E L Record
Oct 4. 1878 McCauman

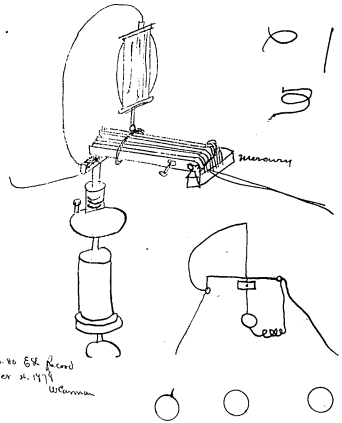
Electric Light Oct 2. 1878

Kreuz

made an experimental Instrument on a Sounder bought at Bro —
It is a lever to hold on end of spiral
B is a flexible lever holding the other end. It is provided with a double point wrapped C
D is regulating point. E is the safety point if the spiral the lever falls by weight W on to point
Make spring C very delicate and put hold back close to point

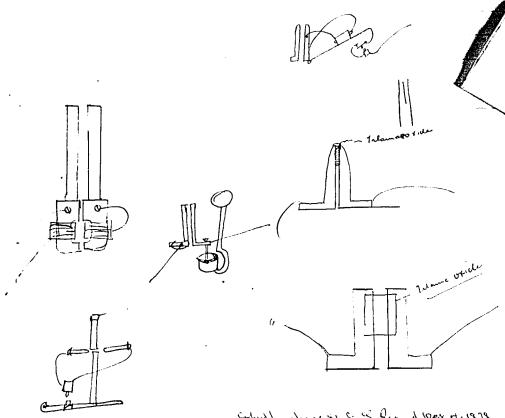


Copied from page 79 E & Record
Oct 4, 1878. W Carman



Copied from page 80 E & Record
Oct 4, 1878
W Carman

Electric Light Oct 3. 1878



Copied from page 81 E & S Record Oct 4, 1878
W Carman

Electric Light Oct 2. 1878

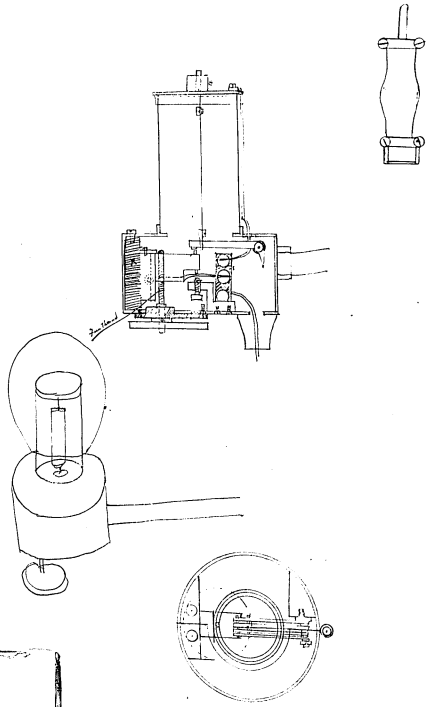
Iridium: got by melting between carbon point very good light by incandescence Has to be very hot before current will go through it. Has a very thick oxide around but with 25 cells current get a deflection of 1 degree on 1 core broke it and got a deflection 30 on 1 core and 16 on 4 core

Manganese: ditto

Bad conductor. cannot get nothing at all through the oxide and only 1½ degrees through the metal when broken! — on 1 core and 25 cells current

Copied from P. 82 E.S. Record Oct 4, 1878
W Carman

Electric Light Oct 3 1878

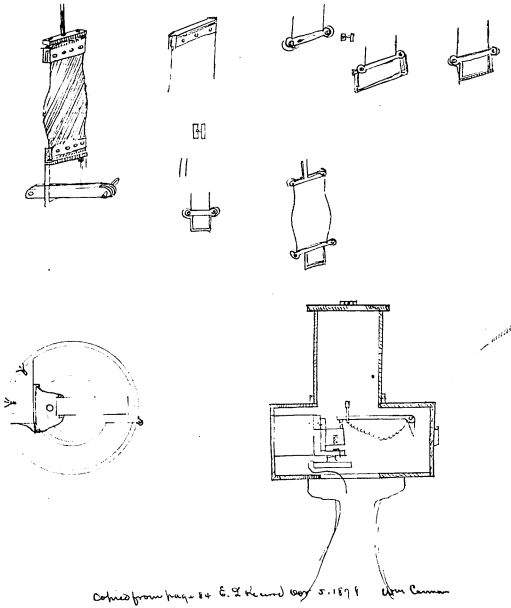


Copied from page 23 E. Light Record oct 5. 1878

W Carman

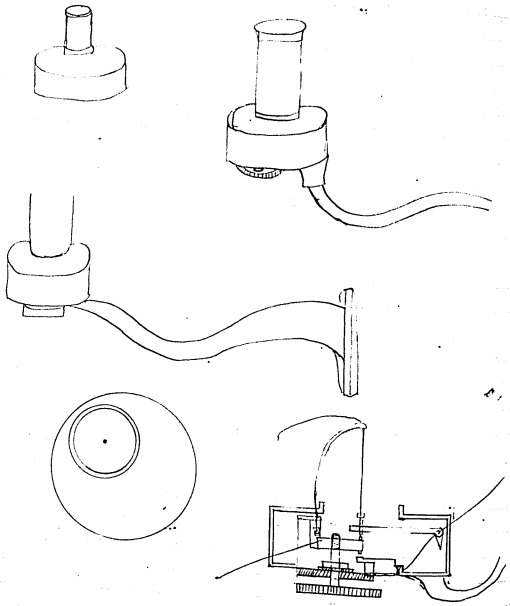
Electric Light Oct 3. 1878

way of fastening the platina foil at the ends



Copied from page 24 E. L. Record Oct 5. 1878 Wm Carman

Electric Light Oct 3. 1878

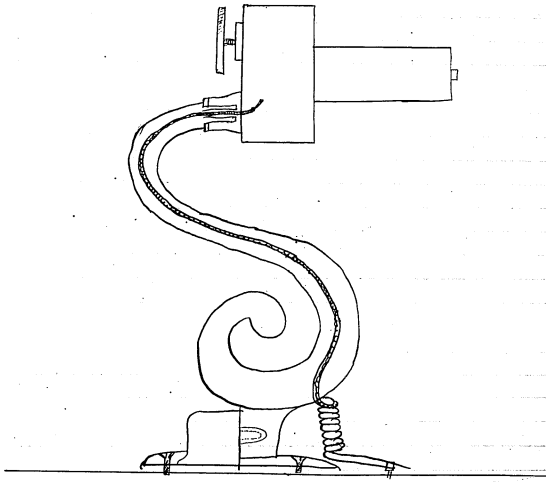


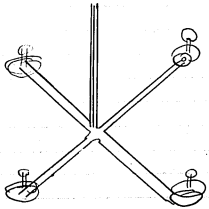
Copied from page 55. 8 Z Recd Oct 5. 1878
W Carman

Electric Light Oct 3. 1878

Subdivision

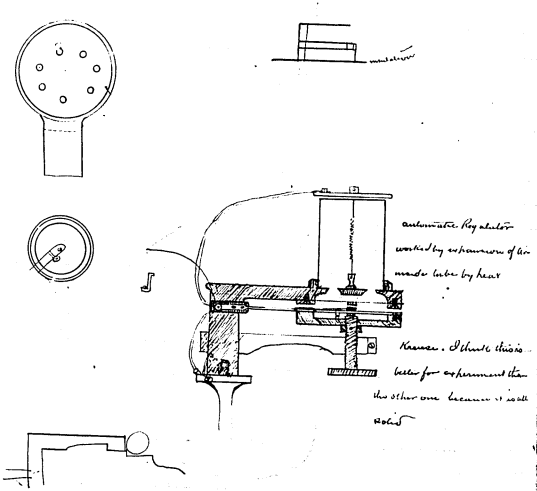
Wall Bracket





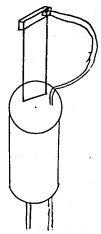
Copied from page 56. 8 Z
Recd Oct 5. 1878
W Carman

Electric Light Sept 30. 1878



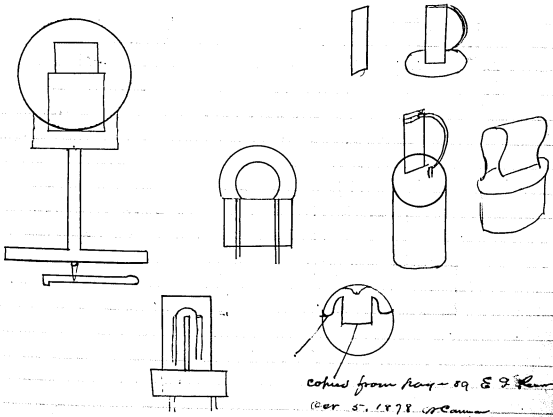
Copied from page 87 Electric Light Record
Oct 5. 1878 Wm Parman

Electric Light Oct 4. 1878



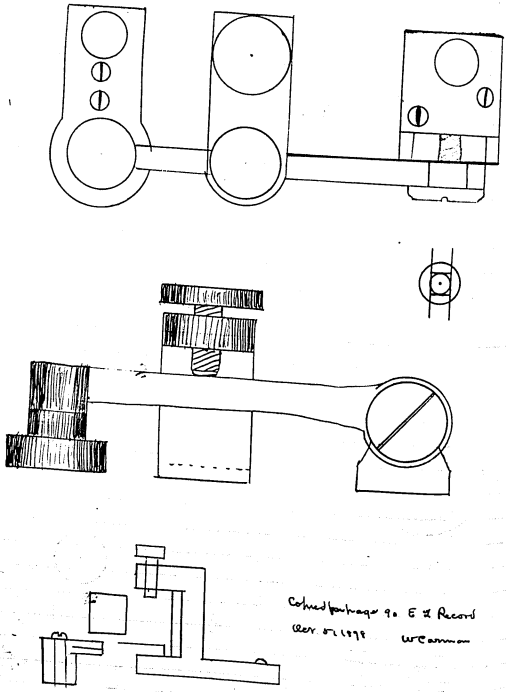
Copied from page 88 E L Record Oct 4 1878
Wm Parman

Electric Light Oct 4. 1878



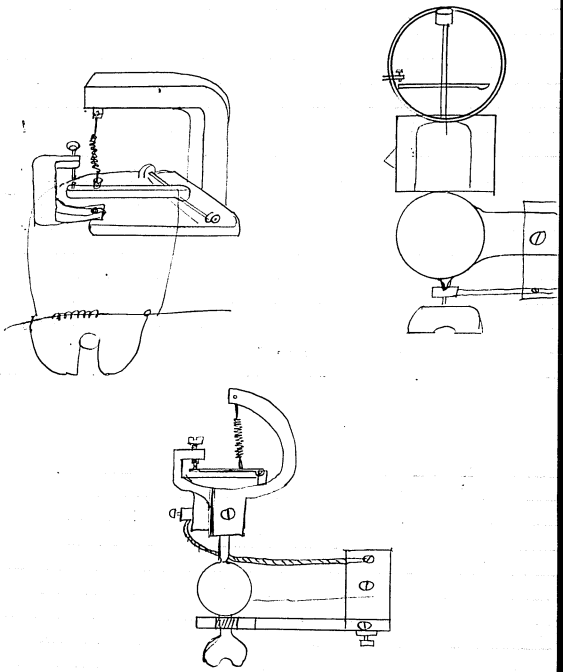
Copied from page 89 E L Record
Oct 5. 1878 Wm Parman

Electric Light Oct 3. 1878



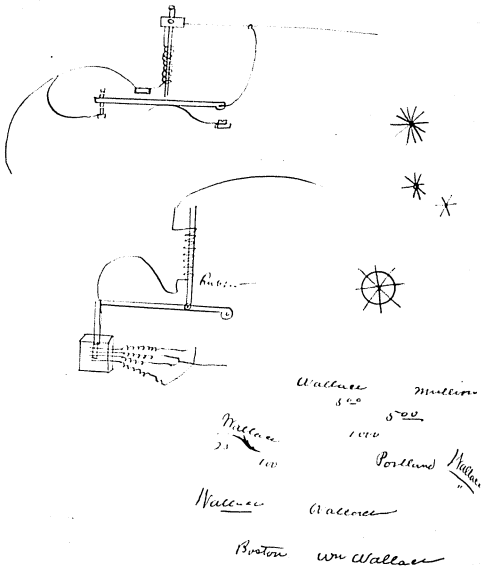
Entered from page 90 E & L Record
Oct. 5. 1878 W Cannon

Electric Light Sept 9. 1878



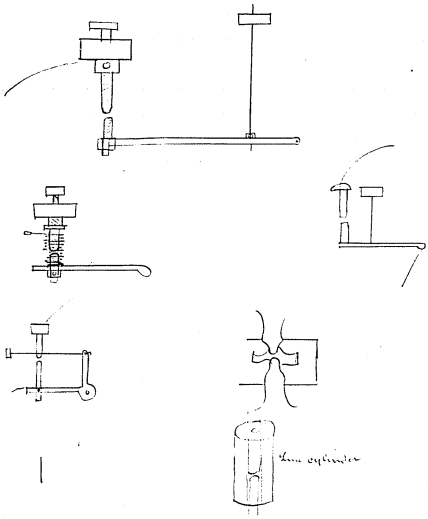
Entered from page 91 E & L Record this 7th day of Oct 1878
Wm Cannon

Electric Light Sept 9. 1878



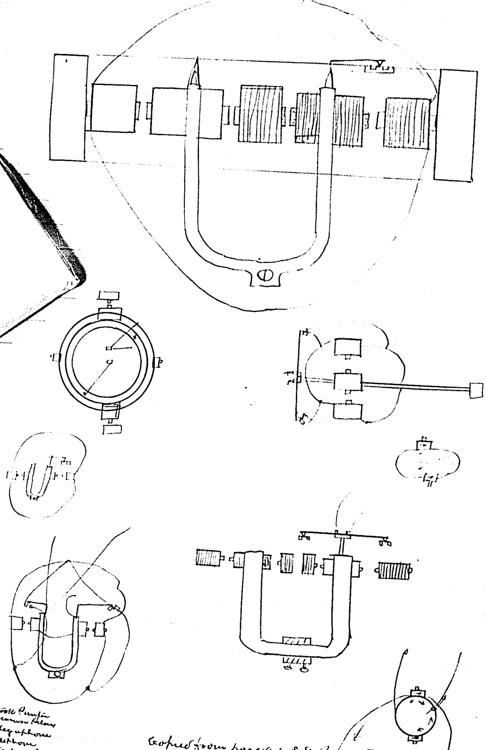
Copied from page 94 Electric Light Record
Oct 7. 1878 W Cunnan

Electric Light Sept 25. 1878



Copied from page 93. & 2 Records
Oct 7. 1878 Wm Carman

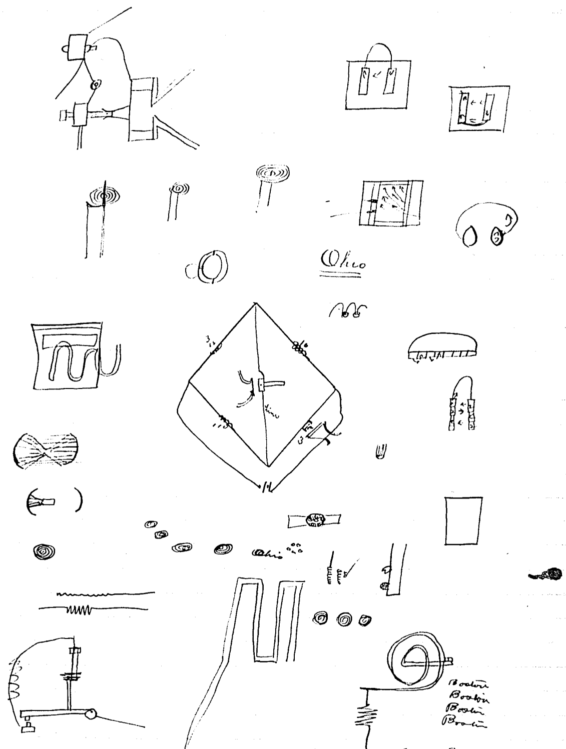
Electric Light Sept 25. 1878



Stock Printer
Pressure Relay
Megaphone
Telephone
Electric Pen
Tasimeter
Phonograph
Reflecting Thermostat
" Voltameter
Resonant Fork
Motograph Relay
Gravitation Relay
Musical Telephone
Autographic
Aerophone
Harmonic Engine

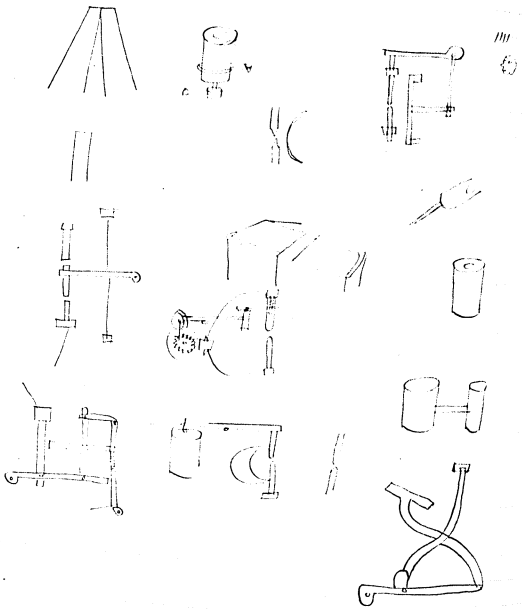
Copied from page 94 E. L. Record Oct 7. 1878
Wm Carman

Electric Light Sept 27. 1878



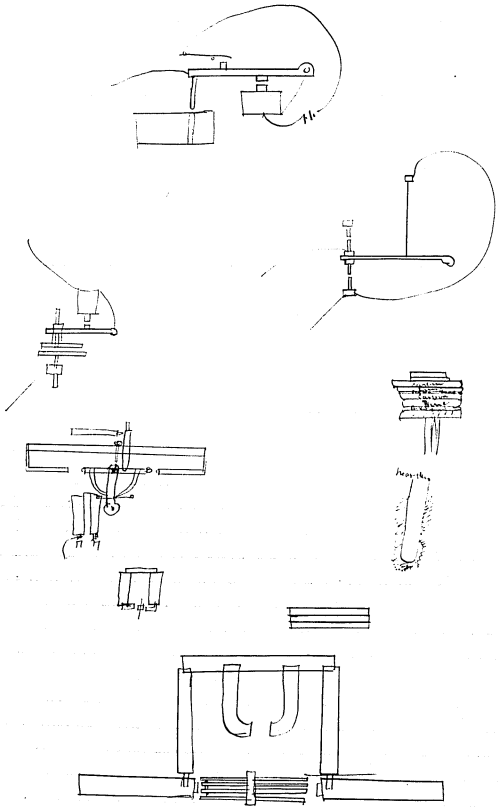
Copied from page 95. E. L. Record Oct 7. 1878
W Carman

Electric Light 1878



Copied from E. L. Record Page 46. Nov 7. 1878 Com Carman

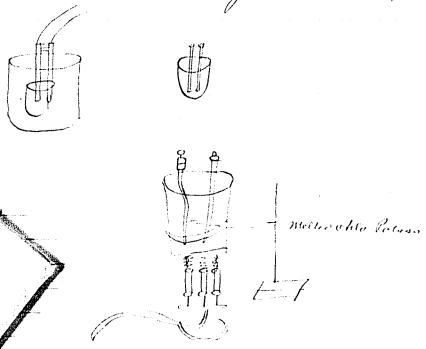
Electric Light Sept 27. 1878



Copied from page 47 E. L. Record Nov 7 1878

W Carman

Electric Light Sept 28. 1878



Copied from page 98 E & L Record Oct 7. 1878
W Carman

Nov 27. 1878

Electric Light, make wedges of Platinum with Aluminum
Fine mica platinum for incandescence. I think that a better aluminum or Platinum will get Rid of the brittleness
Between the two cells which I have wound the incandescent strips
fine finely divided. Ammonia-alum this will melt and
the water will evaporate, this will keep heat from radiating
Try Chromium. between platinum points. make some sulphur
silver by melting (Hydrosulphuric Acid Chl ag) Sulphide Silver. to
malleable & soft may make a fine for telephone
Try powered antimony & Bismuth (carefully powered) for telephone
buttons
Also amorphous Antimony (to make X. P Hot - y Big Blow
Note coat thin form plate with 1/16 inch of melted resin. Shellac
to crucible - make a horse rocked tin diaphragm
Try Tungsten = to make (Big Blow P H2 L)
Molybden. —— —— (" ")

Copied from page 44. E & L Record Oct 7. 1878 W Carman

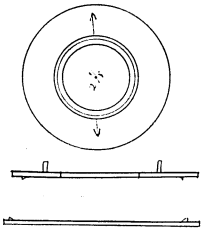
Electric Light Sept 27. 1877

make a lamp wick of pressed platinum black and
asbestos on outside. absorbing a spirit

Electric Light Try palladium

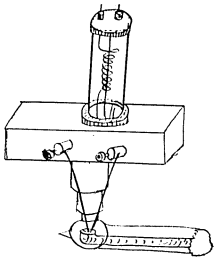
Copied from page 100 E. & L Record Oct 7. 1878
Wm Carman

Electric Light Oct 5. 1878



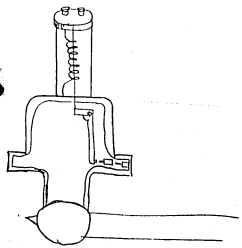
Copied from page 101 E & L Record Oct 7. 1878
W Carman

Electric Light Sept 17. 1878



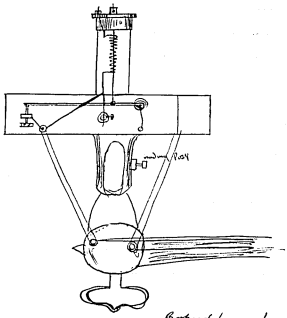
Copied from page 102 E. L. Record Oct 12. 1878
Wm Carman

Electric Light Sept. 17. 1878.



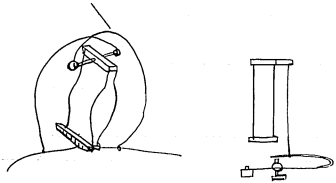
Copied from page 103 E. L. Record Oct 12. 1878
Wm Carman

Electric Light Sept 19. 1878



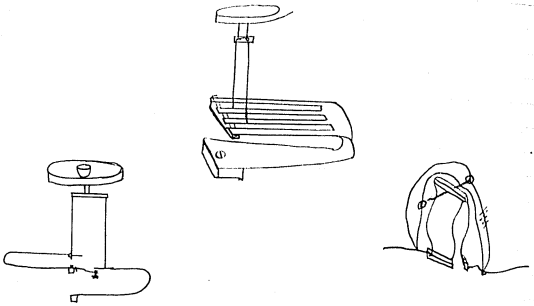
Copied from page 104 E. L. Record
Oct 12. 1878 Wm Carman

Electric Light Oct 5. 1878



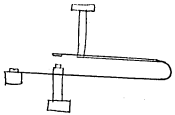
Copied from page 105 E. L. Record Oct 12. 1878
Wm Carman

Electric Light Oct 5. 1878



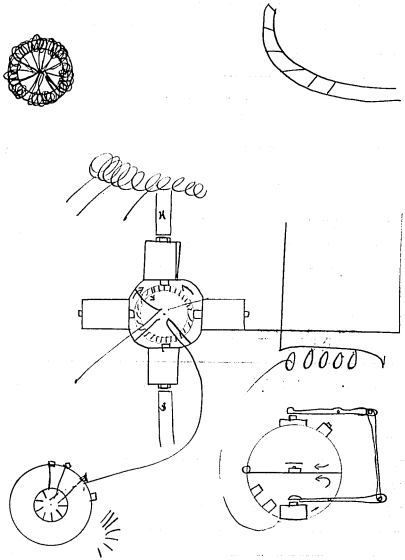
Copied from page 106 E L Record Oct 12. 1878
H. Carman

Electric Light Oct 7. 1878



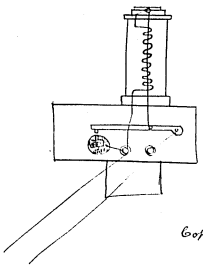
Copied from page 107 E L Record Oct 11. 78
H. Carman

Electric Light Oct 9. 1878



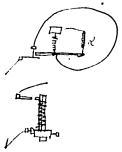
Copied from page 108 E. L Record Oct 12. 1878
H. Carman

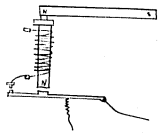
Electric Light Oct 9. 1878

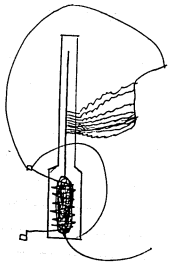


Copied from Page 109 E & S Record Oct 13. 1878
W Carman

Electric Light Oct 9. 1878

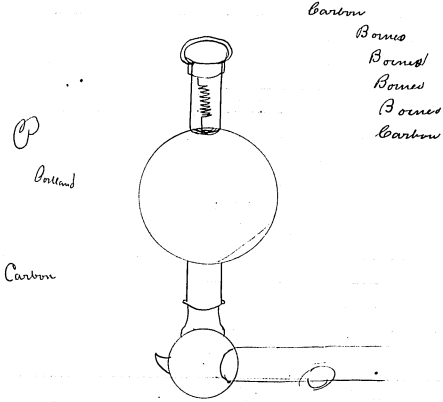






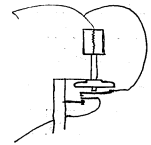
Copied from Page 110 E & S Record
Oct 12. 1878 Wm Carman

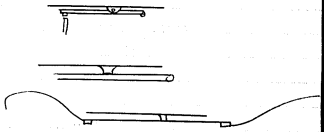
Electric Light Oct 9. 1878

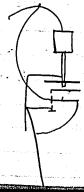


Copied from page 111. E. & S Record
Oct 12. 1878 W Carman

Electric Light Oct 9. 1878



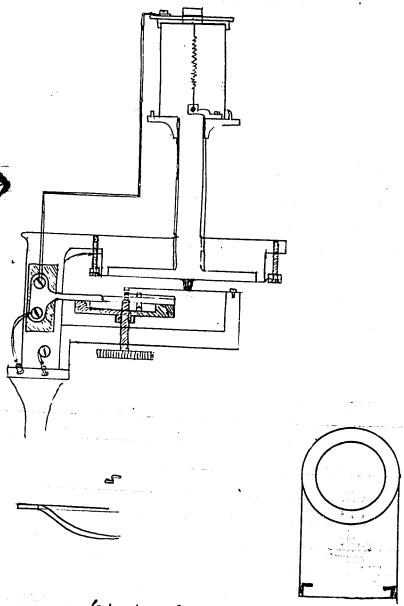




Copied from Page 112. E. & S Record Oct 13. 1878
Wm Carman

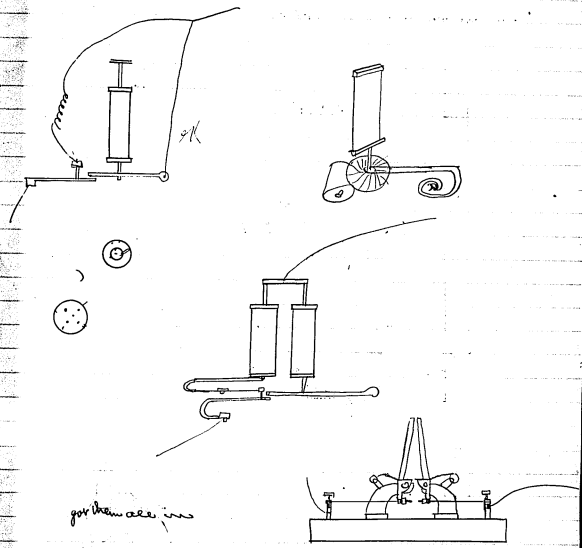
Electric Light Oct 7, 1878

Light regulated by expansion of a column of air heated



Copied from Page 113. E & Records Oct 10 1878
von Cannon

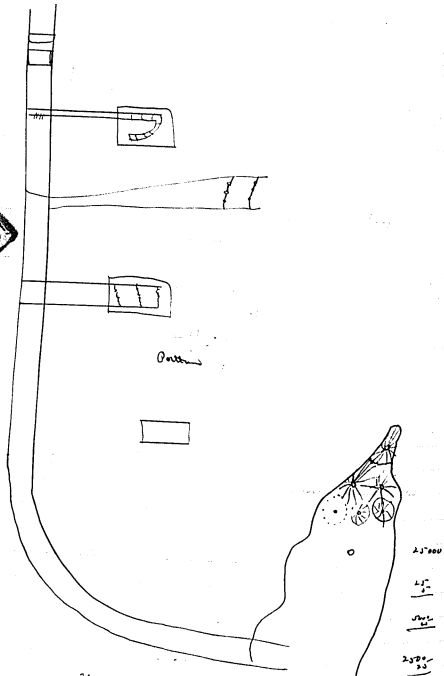
Electric Light, Oct 8, 1878



gas therm alec. inc

Copied from P. 114 E. & Record Oct 14. 1878
von Cannon

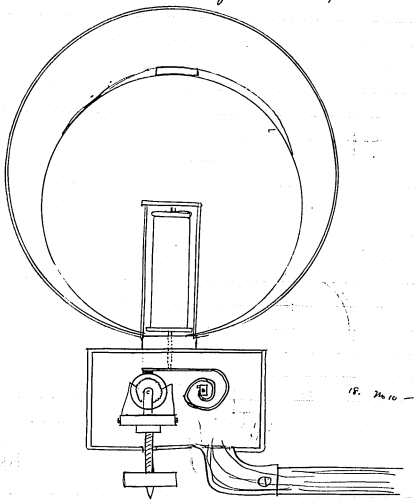
Electric Light Oct 8. 1878



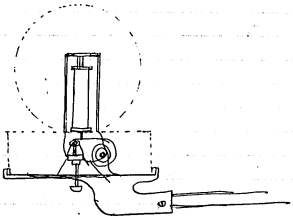
Copied from Page 115 E. L. Record Oct 14 1878.

W Carman

Electric Light Oct 8. 1878



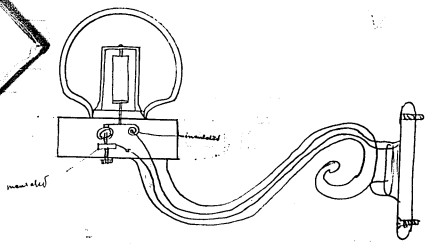
18. No 10 — 1/4 dia



Copied from Page 116 E. Light Records Oct 14. 1878

W Carman

Electric Light Oct 8. 1878



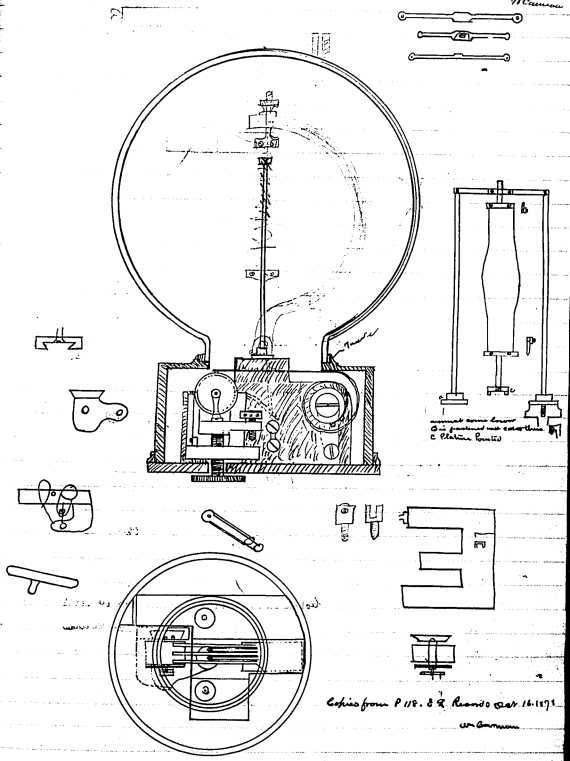
Copied from page 117 E. L. Record Oct 16. 1878

W Carman

Electric Light Oct 9 1878

The sketches drawing done on this page were drawn on Oct 23. 78

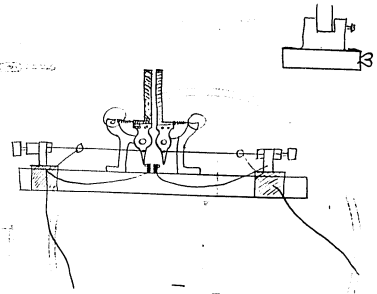
W Carman

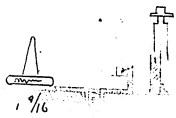


Copied from P 118. E. L. Record Oct 16. 1878

W Carman

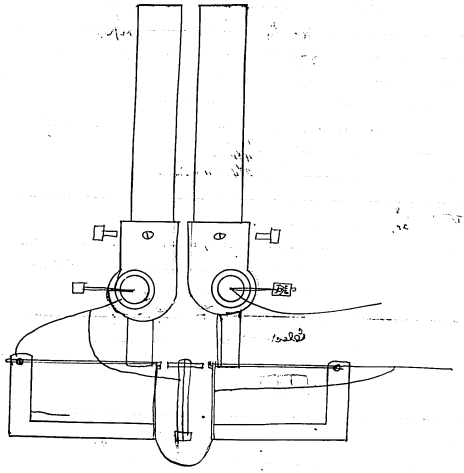
Electric Light - Oct 9. 1878





Lecture on page 119 - E. & Record Oct 14. 1878
W. Carman

Electric Light - Oct 12, 1878



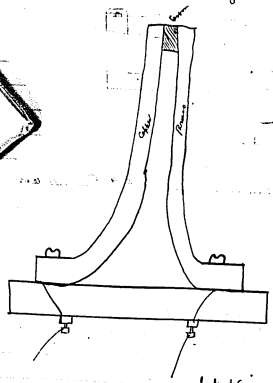
Lecture from Page 120 E & Records Oct 14. 1878
W. Carman

Electric Light Oct 14. 1878

Copied from page 121 E & Record Oct 14 1878

M Carman

Electric Light Oct 9. 1878

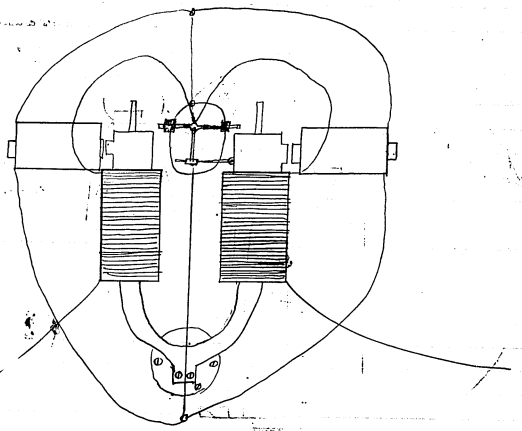


Copied from Page 122 E & Record Oct 15 1878

M Carman

Electric Light Oct 18. 1878

Horseshoe magnets Electric Generator

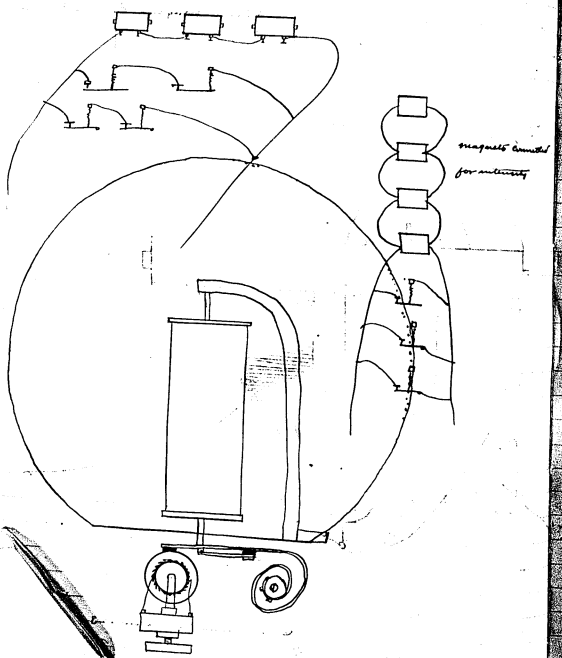


Copied from E & Record 123 Page Oct. 19. 1878

M Carman

Electric Light Oct 8. 1878

Three magnetos connected for intensity



Copied from page 124 E & Recd Oct 28. 78

Mc Cormick

Electric Light

Nov 15th 1878

Law.

With a given wire having 1 Ohm resistance and certain length brought to a given degree of temperature by given battery. It will when coiled in such a manner that but one quarter of its surface radiates, its temperature will be increased 4 times as, — + battery will bring it to the temperature of straight wire. Or the same battery including wire whose total resistance is 4 ohms is inserted will bring it to the same temperature as straight wire.

This was actually determined by trial.

The amount of heat lost by a body is in proportion to the radiating surface of that body. If one square inch of platina be heated to 100 deg it will fall to say zero in one second, whereas, if it was at 200 deg it would require 2 seconds.

Hence in the case of incandescent conductors if the radiating surface be 12 inches and the temperature on each inch be 100 or 1200 for all, if it is so coiled or arranged that there is but 1/4 or 3 inches of radiating surface then the temperature on each inch will be 400. If reduced to 3/4 of an inch it will have on that 3/4 1600 deg Fahr. notwithstanding the original total amount was but 1200 because the radiation has been reduced to 3/4 or 1/57 units, hence the effect of the lessening of the radiation is to raise the temperature of each remaining inch not radiating to 1200 deg. If the radiating surface was reduced to 3/32 of an inch the temperature would reach 6400 deg Fahr. To carry out this law to the best

advantage in regard to platina &c then with a given length of wire to quadruple the heat we must reduce the radiating surface to ¼ and to do this in a spiral ¾ must be within the spiral & ¼ outside for radiating = hence a square wire or other means such as a spiral within a spiral must be used. These results account for the enormous temperature of the Electric Arc with one horse power; As for instance if 1 H.P. will heat 12 inches of wire to 1000 degs Fahr and this concentrated to have ¼ of the radiating surface it would reach a temperature of 4000 degs or sufficient to melt it but supposing it impossible the further concentration to ⅛ its surface it would reach a temperature of 16000° and to 1/16 its surface which would be about the radiating surface of the Electric Arc it would reach 64000 degs Fahr, of course when light it radiates in great quantities not quite these temperatures would be reached

Another curious law is this. It will require a greater initial battery to bring an iron wire of the same size and resistance to a given temperature than it will a platina wire in proportion to their specific heats, and in the case of Carbon if a piece of Carbon 3 inches long ⅛ diameter with a resistance of 1 ohm: it will require a greater battery power to bring it to a given temperature than it would a cylinder of thin platina foil of the same length diameter and resistance because the specific heat of Carbon is thirty times greater, besides if I am not mistaken the reflection of a roughened body for heat is greater than a polished one like platina which may be published

A gas jet equals a Jablochkoff Candle when concentrated in the same space.

A gas jet has 10 square inches radiating surface 15 candle p.
If reduced to 2½ " " " " 60 " "
" " 0.62 " " " " 240 " "
" " 0.15 " " " " 960 " "

The latter radiating surface is about equal to the radiating surface of the arc of a Jablochkoff Candle, hence an ordinary gas jet if concentrated to the size of the Jablochkoff arc would give the same light, or in other words the same power which gives a gas jet of 15 Candle power will give 1000 by concentration

If the radiating power or time of a substance is decreased, the gain in light is directly to the decrease for instance if I could with platina coils obtain 4 burners of 15 C.P. each per H.P. then by reducing the radiating power 50 per cent I would obtain 8 burners.